ECONOMIC GEOGRAPHY OF INDIAN REPUBLIC

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Economic Geography of Indian Republic

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PREFACE TO THE FIRST EDITION

This is a modest attempt to write the Economic Geography of such a vast country with such varied resources. During his fourteen years' lecturing on Economic Geography at the University, the author has felt the necessity of a small book which will give the future citizen of India a bird's-eye-view of the geographical environment in which they have been born and the economic resources that are theirs to develop. In these days when battles are fought not for principles but for 'living space', every Indian must know the possibilities of his own 'living space'. There are a number of books on the subject written either from the point of view of the foreigner whose interest is in 'exploitation', or by people who confuse Economics with Economic Geography. The present book tries to deal with the development of India's resources as based on geographical factors. A full discussion, therefore, of climate, physical features, vegetation, and soil has preceded the survey of economic resources. In order to help the students in their preparation for examination, questions have been added at the end of every chapter. A large number of sketch maps and diagrams have been given to facilitate the study of the subject.

University of Allahabad,
August 19, 1939

R. DUBEY

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INTRODUCTION

India was described as 'a jewel in the British Crown.' But when we look at the squalor and poverty of the people of India, considering the vast resources of the country, we cannot fail to remark that the custodians of the 'Crown Jewels' failed miserably to discharge their duty. They did not try to keep this 'jewel' bright. The fact that a country so rich in economic resources as India, should be so poor does not redound to the credit of the rulers.

The poverty of the people of India is, because the resources of the country have not been developed. They have not been even properly surveyed. It was only very recently that the Government's interest in the successful prosecution of the two World Wars led to this survey and development to a small extent. But, considering the rapid progress made by such small countries as Japan and Germany, before these wars the efforts in India seemed half-hearted.

The vast, though undeveloped, resources of India naturally make it 'A LAND OF THE FUTURE', which will acquire its rightful place in the world when these resources are developed. To help India to attain to her greatness in future, Indians' first interest in India should be to have a full knowledge of her resources. We should know the extent and the geographical distribution of the present, as well as the potential resources of our country. This can be done only through the study of the Economic Geography of the country.

But the world outside has also got an abiding interest in India. The population map of the world shows certain areas of denser population. Two of these areas occur in Asia ; one is India and the other, China. Of these two, India gives shelter to more than one-fifth of the total population of the world. World's interest, therefore,

centres on India as a country where such a large proportion of its population has found shelter.

India gave shelter to the Aryan civilization which took root in its soil and spread far and wide from here, subordinating for a time other civilizations of the day. The world's interest, therefore, centres on India also as a home of the Aryan culture.

India's northern boundary is formed by the highest mountain of the world whose highest peak, the Everest, has defied Man even to the present day. The world's interest centres on India, therefore, also as a land of adventure where Man has yet to conquer the highest peak of the world.

Our interest, as students of Economic Geography, however, centres on India as a land of vast economic resources which have not yet been developed.

The idea of developing economic resources is a new idea in India and arose only out of contact with the Western peoples. For it must be admitted that 'material culture' was never a strong point in the spiritually-minded India of the past. No doubt, there are evidences to show that the Indians practised in the past highly developed arts. These arts must have been practised, however, 'for the sake of art' rather than for any considerable monetary gain. These arts could not have been, therefore, widely spread in the country. The two most important elements of material culture, as used in the modern sense, capital and the market, must have been lacking then. A spiritual culture has obviously no interest in 'capital' and 'market.' These are out of the question in a society which does not possess the most efficient means of communication. The merchant who comes into frequent contact with people and studies their material wants is the person most interested in 'economic resources,' and not the ascetic who runs away from the world.

The first effective contacts of India with a merchant of this sort originated through the British, only a few

hundred years ago. Our economic resources have not yet, therefore, received full attention. It is only within the last few years, when the Indians began to visit Europe or America in increasing numbers to see for themselves the economic or material progress achieved there, that attention has been paid to the survey and development of our economic resources.

The survey is still incomplete and the problem of development still baffles solution.

India's neighbours on its land frontiers, excepting now Pakistan, are countries that are hilly and semi-arid. They are not rich in natural resources. Their dry climate is, however, healthy and breeds sturdy warriors. India's rich plains have always been an attraction for these poor but strong neighbours. All invasions in India have, therefore, come from the North-west where nature opened easy passes, like the Khyber, into her mountain wall. In peace-times, these passes enabled India to maintain commercial relations with far-off countries.

India stands at the head of the Indian Ocean. There is no other ocean in the world which is named after a country. The Indian Ocean is the only ocean that is named after a country. Two other points are of significance in this situation. India is situated at the southern margin of the big land mass of Eurasia. This naturally, links it with the Air Pressure Systems of Asia.

In the modern world, the opening of the Suez Canal has enhanced the importance of India's position. For the routes emanating from this canal and the Strait of Malacca are forced to pass near India. The Indian Ocean has very few islands to serve as supply bases for the ships. The ships plying to Australia, therefore, have to visit some port in India or in Ceylon. But her coastline being regular, very little use has been made by Indians of their situation at the shores of this big ocean. It is true that in the past coastal boats kept certain parts of India into touch with Arabia on the west and South-eastern Asia on the East. But such a contact was necessarily limited. For it must

be remembered that the most important centres of activity in India lay in the interior, in the Indo-Gangetic Basin, far from the coast. With the advent of the British everything changed. The British being a maritime nation, India now developed an ocean contact with the outside world. Her land contacts now declined. The most important centres of activity now shifted to the coasts where the British ships contacted us. The most favourable spots on the Indian coast gradually developed into good seaports. Calcutta, Bombay and Madras became the leading ports as well as the centres of European civilisation in India. The forces of modernisation gradually spread from the port towns into the interior chiefly through English education and the railways which were built to connect the port towns with the interior.

The surface area of India is about 12,00,000 sq. miles. This area places India amongst the biggest countries of the world. The following table compares the areas of some of the biggest countries of the world :—

IN ASIA

Siberia* ...	... 16	lakh sq. miles
China (Proper)	... 15	,, ,, ,,
Mongolia ...	... 13	,, ,, ,,
India ...	... 12	,, ,, ,,

OTHERS

U. S. S. R (Russia) in Europe	... 76	lakh sq. miles
Canada ...	... 35	,, ,, ,,
Brazil ...	... 32	,, ,, ,,
U. S. A. ...	... 29	,, ,, ,,
Australia ...	... 29	,, ,, ,,

*The present administrative area of Siberia has been reduced from the old area, a large part of it being included in Russia in Europe.

An important feature of the Indian area is that most of it is in the service of Man. In Russia and Canada, on the other hand, vast areas remain buried under perpetual snow. In Australia, there are large areas of desert, useless to Man. In Brazil, there are vast areas under tropical forests. Even in the U. S. A. more than 11 lakh sq. miles are included in the Western States which are mostly a desert. This consideration naturally places India in the forefront among the countries of the world.

In population, India occupies an important place in the world. The following table gives the population, in 1950 of the countries whose areas have been compared above :—

	Millions
India	361
Siberia	11
China	463
Mongolia	7
U. S. S. R.	195
Canada	13
Brazil	49
U. S. A.	150
Australia	8

Taking into consideration this large area and this large population, people have often styled India as a 'continent' or a 'sub-continent.' These people have obviously emphasised the differences among the people that are naturally to be expected where the numbers are so large. God has not made any two people alike in all details. Do we then emphasise the points of differences among the members of the same family or the points of unity ? By laying emphasis on these differences, we destroy the family. Similarly, we can also destroy the community and the country. Once we destroy this unity, the systematic development of economic resources becomes well-nigh impossible.

What country is there in the world where differences do not exist? Even in a small country like Great Britain which has hardly one-eighth of the population found in India, there are differences among people. The Welsh, the Scotch and the English do not see eye to eye in all matters. They have differences in their physical features. Just consider the different races that went to England to make the present English nation! The scandinavians, the Germans, and the French, all went there. To which blood does the present Englishman belong? There are local differences of relief and climate from one part to the other. The Welsh, the Scotch and the Irish have their own language which is distinct from English. But we do not call Great Britain a 'continent'. We do not call Russia, which has Muslims, Christians, Jews and others living side by side, a continent. Why should India then be singled out for this? It cannot be said that it is to emphasise the size of India; for in that case, there are bigger countries.

Common outlook in essentials of life should be the main test to decide whether India is a country or a continent. The boundaries of India are so well defined that they leave no doubt in our minds that India is a country, a separate whole. The mountain boundaries towards the land frontiers and the sea on the other separate India almost completely from Asia.

The geographical considerations make agriculture the dominant occupation of all people in India, Muslims and Hindus alike. The crops sown by them are alike; the methods of cultivation followed by them are alike. When the monsoon rains fail, they fail alike for the Hindu and the Muslim, or the Sikh. The common interest of the people lies, therefore, in safeguarding India's agriculture.

There are, of course, differences in culture and language from one community to the other; from one province to the other. But these differences have always been subdued by the peculiar geographical characteristics of India. The language of the ruler has always dominated

the local languages, and the people of no two provinces of India have ever found it difficult to be understood by each other because the local languages of the provinces differ.

India is, therefore, as much a country as any other in the world.

In spite of the present backward economic development, India has an economic importance of her own. Her teeming millions are looked upon by the world as potential buyers. The importance of the Indian market for the European manufacturer has been emphasised in this book elsewhere. India is more or less a monopoly producer of certain commodities in the world, like mica, shellac, etc. Her cotton, iron, manganese, tea, oilseeds and some other commodities are in demand over a large part of the world. Her developing industries require machinery and skilled labourers. What country is there in the world, with machinery and skill to spare, which is not anxious, therefore, to be invited to take a hand in this development?

The following pages attempt to give the basis of India's economic importance. This economic importance has been greatly affected by the creation of Pakistan. The partition has taken away from India some of the most fertile and developed agricultural areas. This is shown by the following tables showing the higher yields per acre in Pakistan, and the loss India suffered due to partition :—

The loss in industrial raw materials is not confined to raw cotton and raw jute, the supplies of raw skins, salt, and raw materials for paper industry have also been considerably affected. In respect of the manufacturing capacity, minerals (other than salt) and seaports India's loss has been negligible.

One fact, however, stands out prominently from the above discussion. India and Pakistan cannot make progress without each other's help. If India needs Pakistan's raw jute, Pakistan needs India's coal, cotton cloth and other manufactured articles.

Yields per acre in lbs.
1945–46

	Indian Republic.	Pakistan.
Rice	703	837
Wheat	541	668
Cotton... ...	75	170
Jute	1029	1365
Tobacco ...	726	1047

Results of Partition.
(Figures of 1945-46 in lakhs).

	Indian Republic.	Pakistan.	Indian Loss%
Area (sq. miles)	12	3½	22%
Population	3327	661	17%
Forest (acres)	625	52	8%
Cultivable Land (acres) ...	2086	552	21%
Irrigated Land (acres) ...	390	195	33%
Foodgrain (acres)	1779	411	19%
„ (Tons)	407	135	25%
Sugarcane (acres)	32	6	16%
„ (Tons)	45	8	15%
Oilseeds (acres)	230	15	6%
„ (Tons)	50	2	4%
Cotton (acres)	113	33	22%
„ (Bales)	21	14	40%
Jute (acres)	5	18	78%
„ (Bales)	14	63	82%
Tobacco (acres)	10	2	17%
„ (Tons)	3	1	25%
Rice (acres)	580	227	28%
„ (Tons)	182	85	32%
Wheat (acres)	244	105	30%
„ (Tohs)	59	31	34%

[NOTE :—Tables calculated from Government of India Publication].

CHAPTER I

CLIMATE

Climate occupies the fundamental position in the study of Economic Geography. On the one hand, it determines, to a large extent, the production of commodities, and on the other, it controls and creates markets for them by determining the wants of men. In no other country is the production of commodities so dependent upon climate as in India. Millions of poor farmers gaze at the skies during the summer months in the hope of seeing the clouds that bring them the rains which start the agricultural operations of the year. Even in these days of economic progress, untold misery is the lot of the Indian farmer if, perchance, the rains fail; or some other climatic phenomena destroy his crops. Climate affects not only the agriculture, but all other aspects of India's life. Our clothing, our houses, our roads and railways, our food and our very health and capacity to work depend upon climate.

India's climate is produced by :—

(a) her relation to the big land mass of Asia; and (b) her relation to the Indian Ocean. The Monsoon type of climate, under which Indian climate falls, is directly the outcome of the extraordinary pressure conditions that develop in Central Asia during the winter and summer months. The word 'Monsoon,' derived from the Arabic word 'MAUSIM,' meaning season, implies seasonal change of prevailing winds. During winter, the prevailing winds are off-shore from land; during summer, these winds become on-share from sea. This change from the land winds to sea winds and *vice versa,* is the cause of all the characteristics of a monsoon climate.

To understand Indian climate, therefore, it is necessary for us to study the pressure conditions of Central and South-eastern Asia, which bring about this change of winds.

In the following map is given the distribution of air pressure for January in Asia. It will be noticed that at this time an anticyclone with high pressure covers the land mass of Asia. The centre of this anticyclone is in Siberia near lake Baikal. The average pressure for Irkutsk at this time is 777 mm. A secondary centre of this anticyclone has established itself in the Punjab: the pressure at Peshawar being 765 mm.

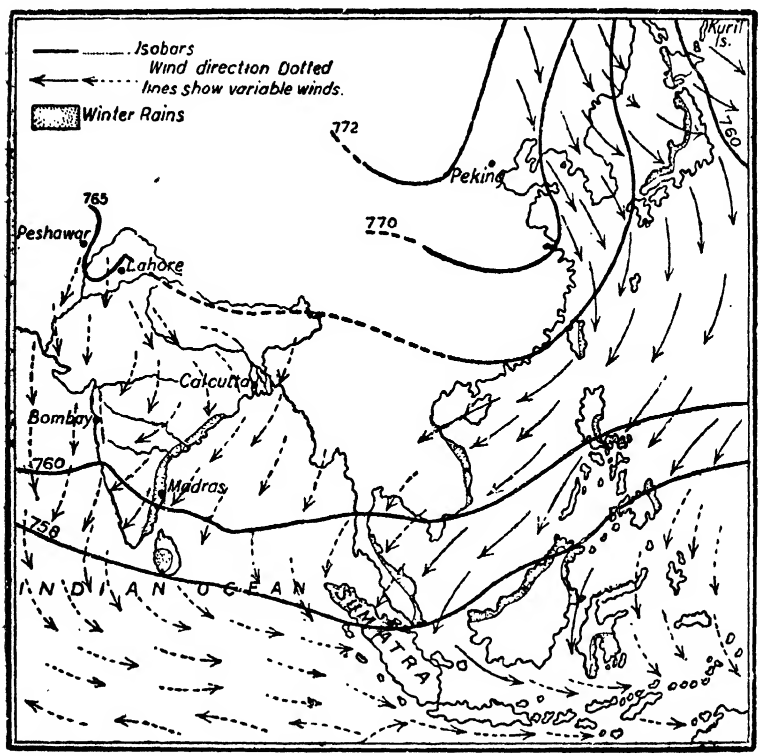

Fig. 1. Pressure and winds for January

As opposed to this, low pressure occurs in the North Pacific near the Kurile Isles, and in the equatorial regions to the south. Further south, in Australia also there is low pressure, as it is summer there. As the wind blows from the high pressure to the low pressure region, this pressure distribution naturally places the whole of the

eastern and southern Asia under the regime of land winds which are called 'Winter Monsoon.' These are usually dry, off-shore winds which merge, over part of the area, with the N. E. Trade Winds. The Winter Monsoon may also be called the Dry Monsoon. As appears on the map, these winds blow more steadily in eastern and south-eastern Asia than in the Indian region where they are weak and irregular.

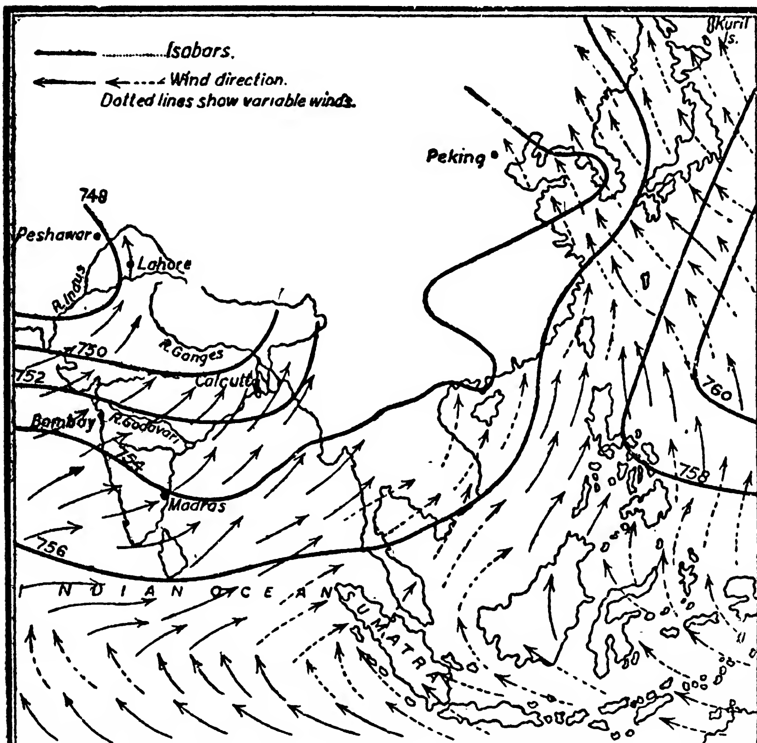

Fig. 2. Pressure and winds for June.

Now, look at the map (Fig. 2) giving the pressure distribution for June. The increasing amount of heat received from the sun and the consequent heating of the big land mass of Asia has changed the entire position. The high pressure area now lies on the Pacific, south of Japan. There is another high pressure area on the Indian

Ocean and in Australia where it is winter now. The continent of Asia, intensely heated, is almost entirely a low pressure area, with three centres of marked low pressure; one of which is in Pakistan near Multan where the pressure, about 747 mm. is the lowest of all the three centres. The prevailing winds, therefore, become on-shore, blowing from the sea to the land.

In the beginning, while the summer temperatures are yet rising, these sea winds are drawn only from over short distances of the sea. But gradually as the low pressure area over Pakistan intensifies, even the S. E. Trade Winds blowing in the southern hemisphere join the general movement of air towards this low-pressure. During May the pressure in Pakistan is about 29.55″, during June it

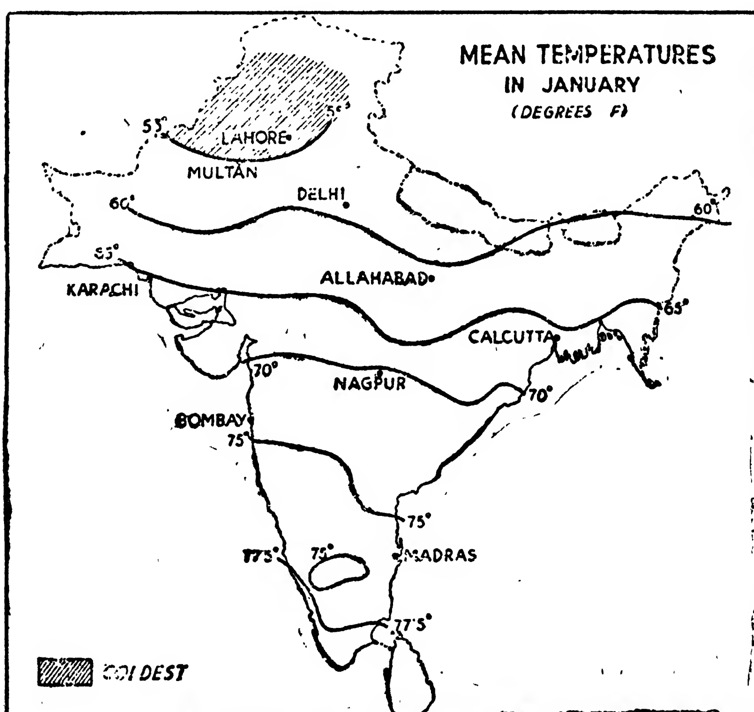

Fig. 3.

becomes 29.50″; but during July it becomes as low as 29.40″ near Multan. This causes the onrush of the monsoon. These winds come to us, almost suddenly, as 'South-West or Summer Monsoon.'

Gradually as the sun starts back on its southern journey, the temperature in India becomes lower and the old pressure conditions re-establish themselves. The South-West Monsoon therefore weakens and we have once again the Winter or Dry Monsoons. The period of transition from Summer to Winter monsoons lasts from September to December, after which the Winter Monsoons are in full control until about May. Thus from June to December, India is under the influence of the South-West Monsoons coming from thousands of miles of warm ocean. From January to May, it is under the influence of the off-shore Dry Monsoons coming from land. The oceanic and land character respectively of these monsoons determine the salient features of Indian climate.

WEATHER IN THE DRY MONSOON

Considering generally, the weather in India during the period of Winter or Dry Monsoon is marked by "clear skies, fine weather, low humidity and light northerly winds."* There is, however, a great difference between this generalised statement and the day-to-day realities. The anticyclone, mentioned above covering North-west India weakens from time to time. This is characterised by the inraid of a number of cyclones which introduce an element of change in the weather conditions of northern India during winter. About nine-tenths of these cyclones come here from the Mediterranean VIA Iran; while the rest are born in Central India or in the Arabian Sea. Their path generally lies along the Himalayas. The country south of 21°N. is not visited by them, generally. These are similar in type to the European cyclones, though not so intense. Most of these depressions give a small amount of rain to the whole of Northern India, and heavy snow-

*Normand: *The Weather of India, 1927.*

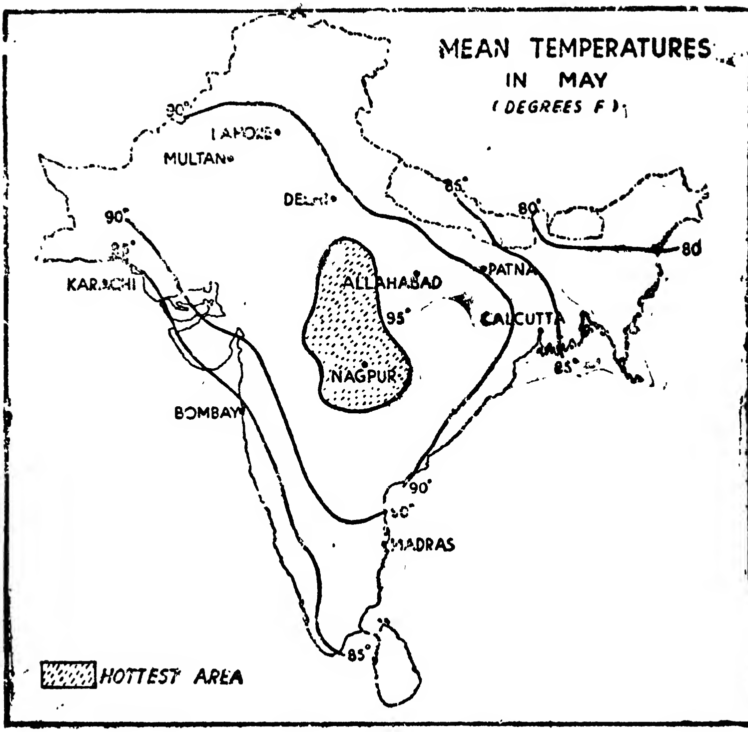

Fig. 4.

fall in the higher Himalayas. The passage of these cyclones is accompanied by marked changes in temperature. Their approach is marked by a rise in temperature and their end is marked by a fall in temperature. It is then that the weather becomes frosty. The amount of showfall from these cyclones in the mountains depends upon the moisture in the air drawn into them. When more of the air from the Arabian Sea is drawn into them the snowfall in the hills is considerable. This is possible only when the path followed by them is more southerly. The path followed by these cyclones is determined by the equatorial doldrums. When the position of the doldrums is more to the north the path of the cyclones in India is more to the north. There is, therefore, less of the air from the Arabian Sea drawn into them. But when

the position of the doldrums is more to the south, the path followed by the cyclones is more to the south. This allows more moisture-bearing air to be drawn into the cyclones, and heavy snowfall in the mountains is the result.

Heavy snowfall in the hills causes a very cold weather to follow the cyclones. Owing to the circular motion of air around the low pressure in the cyclone, the cold air of the snow-covered mountains is brought to the plains of India where a cold wave results.

The first period of the Dry Monsoon is characterised by low temperatures, which are lower in the north-west, where the anticyclone lies, than in the south which is nearer the equator. The temperature during this period throughout the Indo-Gangetic Basin is considerably lower than in the peninsular India. The following table shows this:—

WINTER AND SUMMER TEMPERATURES

	Winter (Jan.)		Summer (May or June)	
	Max.	Min.	Max.	Min.
	F°	F°	F°	F°
Peshawar	63	41	105 (June)	77
Lahore	69	40	106 (June)	79
Delhi	70	48	104	80
Allahabad	74	48	107	80
Nagpur	83	55	100	82
Madras	85	67	98	81

The second period which may be said to begin from March, is marked by an appreciable rise in temperature

due to the northward march of the sun. The Fig. 4 shows that the month of May records the highest temperatures over greater part of India. These temperatures increase from the south to the north and north-west. Thus both the highest and the lowest temperatures in India are recorded during the period of this dry; off-shore monsoon. The country cannot get the benefit of sea during the regime of this monsoon.

The change from the cold to the hot season, about March, is marked by a number of storms which are usually of local origin. They usually originate on land and are due sometimes to the mixing of air at different temperatures drawn from the neighbouring seas. In northern India these storms are sometimes accompanied by hail.

About the close of the period of this dry monsoon, the days in the Upper Ganges Basin are characterised by the blowing of the dry, scorching westerly winds, locally known as 'LOO'. These winds are drawn owing to the unusual heating of the plains during the day. They stop blowing during the night. The afternoons and late evenings are sometimes marked during this period by hurricanes, which also are due to local heating. Sometimes they move at terrific speeds seventy or eighty miles an hour, and cause considerable damage.

But while the 'loo' blows in the north, in the exterme south the proximity of the sea allows oceanic winds to penetrate to some distance into the land and give light showers, as soon as the summer temperatures have risen considerably. These rains are not, however, part of the monsoon rain. They are only light, as the winds drawn are only from a short distance of the sea and are not, therefore, so highly saturated as the south-west monsoon. The south-west monsoon sets in only much later when the low pressure at the equater south of India has disappeared, thus allowing the South-East Trade Winds to be drawn across the equator as south-west monsoons.

Weather in the Wet Monsoon

The Summer or Wet Monsoon is divided into two branches: (i) the Arabian Sea branch and (ii) the Bay of Bengal branch, owing to the peculiar shape of the Indian

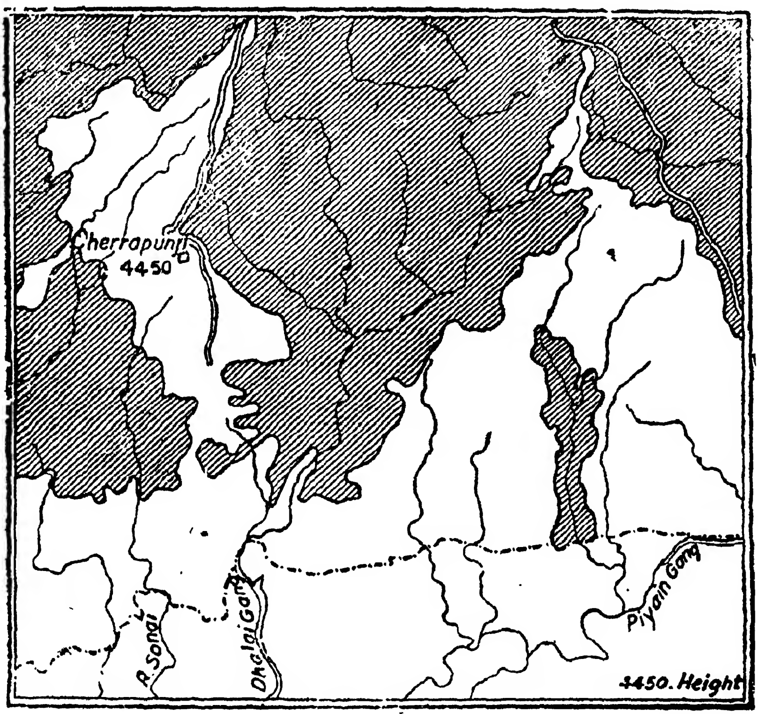

Fig. 5. Position of Cherrapunji, Hills are shaded.

Peninsula. The Bay of Bengal branch strikes land much later, but gives rain to the greater part of the country. The Arabian Sea branch, though more powerful, usually spends itself up in ascending the Western Ghats which deprive it of most of its moisture. Certain currents of the Arabian Sea branch reach the interior of the Peninsula through the Narbada gap and join the Bay of Bengal current in Chhota Nagpur. The Palghat gap similarly

allows this monsoon to reach into the interior of the peninsula.

The Summer or Wet Monsoon is also called the South-West Monsoon, because it blows ORIGINALLY from the south-west. Its direction over India is, however, modified by the general position of the low pressure area in the north-west, to which it is naturally attracted; and the direction of mountains, especially the Arakan hills and the Himalayas. The result is that in U. P. the so-called SOUTH-WEST MONSOON actually comes from the EAST.

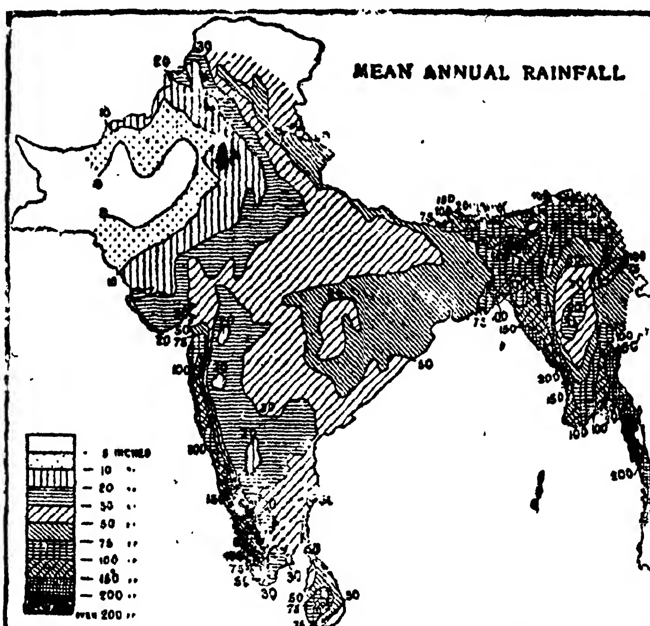

Fig 6

With the advent of the South-West Monsoon there is an appreciable fall in temperature. The high humidity of air, however, makes the moist heat unbearable. The conditions, in fact, in every way resemble those in the equatorial regions.

The chief importance of the West or South-West Monsoon lies in its rainfall. This Monsoon has been blowing for thousands of miles over warm ocean capable

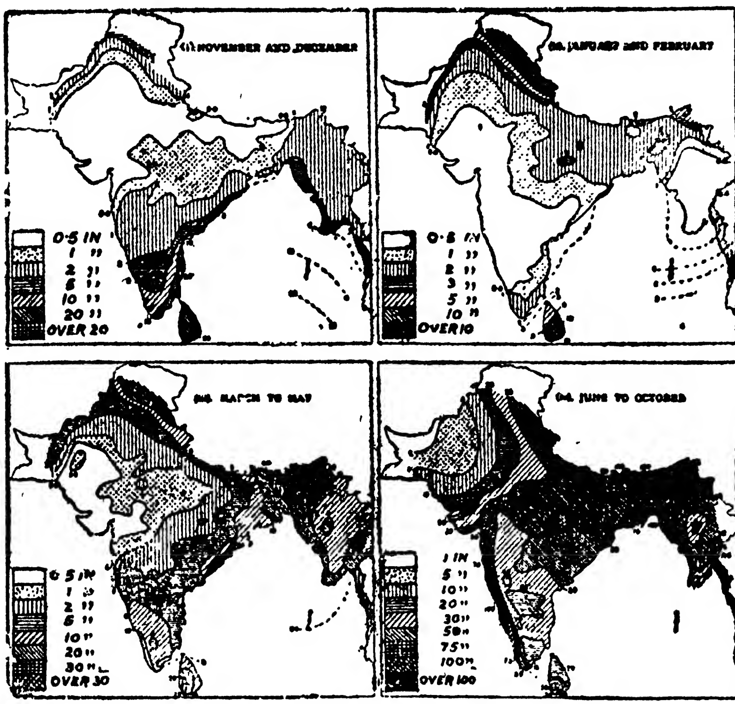

Fig. 7. Mean Seasonal Rainfall

of much evaporation. It is, therefore, highly saturated when it strikes land. The Bay of Bengal branch strikes the Arakan Coast and thence passes on into the funnel-shaped formation of the Garo and Khasi hills, shown in Fig. 5. The ascent of these moisture-laden air currents in this funnel gives Cherrapunji an average annual rainfall of 430 inches which, if allowed to collect, will submerge completely a modern four-storeyed house. After emerging from this funnel, the Monsoon air loses much of its buoyancy and moisture, so that Shillong, which is only about twenty-five miles away from Cherrapunji, gets only about 55 inches of rainfall annually. The Monsoon

currents now follow their path along the Himalayas giving rain until they reach the Punjab where they meet another section of the Arbian Sea Branch. The rainfall decreases as these currents move into the interior, as the supply of moisture in them decreases gradually. The rainfall is greater near the Himalayas, and near the coast in Bengal, than it is in the interior or away from the Himalayas.

Part of the rainfall from the Monsoon in India is OROGRAPHICAL, and part CYCLONIC or CONVECTIONAL. All along the Himalayas and the Western Ghats the Monsoon currents try to ascend the mountain barrier which results in condensation of moisture and rainfall. In this orographical or relief type of rainfall the windward slopes of mountains get more rainfall than the leeward sides which are in the rain shadow. The cylonic rainfall, on the other hand, is due to the passage of a number of depressions or cyclones, some of which are of local origin due to local heating, while others take their rise on the neighbouring sea and move landward.. These depressions intensify and concentrate rainfall in their vicinity. The rainfall is, therefore, sometimes more and sometimes less in a particular locality in India according to the intensity of the cyclone. Consequently, the Summer Monsoon does not give CONTINUOUS rain in any part of India. Bursts of general rain alternate with breaks. Intensification by these depressions often leads to floods. This pulsatory character of the Monsoon rainfall is one of the most important features, and is economically important for the proper growth of crops.

Convectional rainfall also takes place sometimes due to local heating which produces cumulous clouds in the afternoons. This type of rain is strictly local and occurs mostly in autumn or spring (i.e., October and March). Heat produces a local convectional current in the air which rises up. The moisture in that rising current is condensed at some height and clouds form. These clouds, on rising further begin to give rain. The convectional rains in India are generally very light, as

this phenomenon occurs in India at a time when the temperatures are not ordinarily very high. The local heating, therefore, cannot produce very strong convectional currents in the air which could rise very high and thus give much rain.

It is also due to these depressions that lands away from the mountains are able to get rainfall. For ordinarily the monsoon winds try to cross the Himalayas and concentrate their rainfall there only. It is only through the depressions that the moisture-bearing monsoon passes over the plains and gives rain there.

Usually the strength of the Monsoon currents, and the accompanying rainfall increase from June to July and remain steady till about the end of August. The currents then begin to weaken and do not reach far into the interior; that is to say, the Monsoon begins to retreat. This retreat of the Monsoon is due to the retreat of the sun towards the southern hemisphere. The retreat begins first in those parts where the advent of the Monsoon was the latest, that is to say, from places far into the interior. The following table shows the approximate dates when the S.-W. Monsoon starts and ends in certain provinces in India :—

MONSOON TIME TABLE

Province	Commencement	End	Duration days
Bombay	5th June	15th October	132
Bengal	15th June	15-30th October	132-137
U. P.	25th June	30th September	97
Punjab	1st July	14th-21st September.	75-82

The Arabian Sea Monsoon current retreats southwards from Rajputana, Gujarat and the Deccan by a series of intermittent actions. The Bay of Bengal current similarly retreats down the Ganges plain. The low

pressure conditions previously prevailing in North India disappear by October, and are transferred to the Bay of Bengal by the beginning of November. This retreat of the monsoon is followed by dry weather in Northern India and general rainfall on the coastal districts of Madras presidency and Orissa, where October and November are often the rainiest months of the year.

The retreat of the S.-W. Monsoon is associated with a number of storms which affect only the coast, especially along the Bay of Bengal. These storms (or 'Tornadoes' and 'Typhoons') cause sometimes very high tidal waves which do considerable damage in the low-lying areas near the coast. The tidal wave accompanying the Bakarganj storm of 1876 was one of the most destructive on record. About one lakh people were drowned in about half an hour on the alluvial flats of the River Meghna. Only recently a cyclone of this type passed over Bengal details of which were given in a communique as follows:—

"A heavy cyclone from the Bay passed over several districts of Bengal on October 16, 1942. It began about 7 or 8 o'clock in the morning on October 15 and spent itself up in the early hours of the morning of October 17. In the afternoon of the 16th there was a high tidal bore forced up by the cyclone from the Bay which broke into the mainland and devastated a considerable area in the southern part of Midnapore and 24-Parganas. The cyclone was accompanied by heavy rain. At certain places it was as heavy as 12 inches in less than 24 hours. All the rivers in these districts were in heavy flood, due to the tidal bore, rain and the force of the wind. In the worst-affected areas, there was a heavy loss of human lives—the present estimate being not less than 10,000 persons in the Midnapore district and 1,000 persons in the 24-Parganas district. The loss of cattle was even heavier, nearly 75 per cent. As to houses, practically every kutcha house was severely damaged or destroyed."

Distribution of Temperature

The Tropic of Cancer divides India roughly into two equal parts; the Warm Temperate and Tropical. But on account of the monsoon character of Indian climate, very little effect is produced by the Tropic of Cancer on the distribution of temperature in India. The extreme south

is the only part of India where latitude may be said to have a preponderating influence on temperature distribution. But there, too, the peninsular character of land lets in oceanic influences which considerably modify temperatures.

In Northern India, or the part north of the Tropic of Cancer, the temperatures during the winter months are controlled, apart from the slanting rays of the sun in winter, by the anticyclone that covers this area then. The temperatures vary between 55° F and 65° F.

A slight change occurs in these temperatures whenever cyclones disturb the anticyclone. For a few days, marking the approach of the cyclone, the temperatures are slightly higher. For a day or two, signifying the end of the cyclone, the temperatures are slightly lower. It must, however, be remembered that it is during the closing days of the cyclone that the lowest winter temperatures are recorded locally.

In Southern India, or the part south of the Tropic of Cancer, the temperatures during the winter months are controlled by the proximity to the equator and the oceanic influences. The temperatures generally increase from about 65° F. near the Tropic of Cancer to about 80°F. at the sout thern extremity. There are, however, local variations, due to elevation above sea-level or proximity to the sea. Fig. 3. giving the isotherms for January, shows (by the southerly bend of isotherms) that winter temperatures are warmer on the east coast than on the west coast. This is largely due to the higher elevations on the west. This effect of elevation is also brought out clearly by the isotherm of 75° F. enclosing the plateau of Mysore.

The summer temperatures in Northern India are largely the effect of :—

(i) Direct rays of the sun, owing to sun being overhead in the northern hemisphere.

(ii) Continentality, emphasising land influences far from the sea.

(iii) Anticyclone, which maintains steadily rising temperatures.

(iv) Modification by the breaking of the South-West Monsoon which brings rain.

As the sun crosses the equator for the north, temperatures in India begin to rise. But Fig. 4, giving isotherms for May, shows that there is little difference in the summer temperature between northern India and southern India. The isotherm of 90° F.covers the greater part of India, more or less surrounding it. In the neighbourhood of the sea, the isotherms tend to follow the direction of the coast. This is due to the penetration of the oceanic influence.

During June when the sun shines overhead at the Tropic of Cancer, the highest temperatures are not found in that region. The highest temperatures are found in areas that have not yet received the monsoon rains. Thus, the hottest temperatures in India during June and July are in the south-west of the Punjab, Sind, Central India and Rajputana. In all areas where the south-west monsoon has penetrated, the temperatures have come down considerably.

The distribution of day-to-day temperatures over the different parts of India is, however, entirely different from the above generalised, seasonal distribution of temperatures. The temperature may rise above 100°F. in a place in the west Pakistan on a day during summer, and may fall to 40° F. or thereabouts during the night. Both the highest and the lowest temperatures in India have been recorded in Jacobabad in Sind.

There is a considerable range between winter and summer temperature in India, except in Malabar. Malabar may be considered to enjoy the equatorial type of temperature regime, in which the difference between winter and summer temperatures is very little. The range of temperature increases as one proceeds into the interior of the country from south to north. While in Malabar the range between the hottest and the coldest month is about 6° F., and in South-eastern Madras about 12°F., in South-western Punjab it is more than 40° F.

An important feature of the distribution of temperature is the sudden change from winter to summer, and summer to winter. The period of spring and autumn is, therefore, limited in India. This feature is more marked in the north than in the south. The following table gives the temperatures of three different areas to illustrate the comparative steadiness of temperatures during the period of the South-west Monsoon, and the sudden rise and fall of temperature during spring and autumn respectively.

MEAN MONTHLY TEMPERATURES IN DEGREES F.

Area	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.
Punjab, S.-W.	54	58	69	80	90	94	93	90	87	78	66	56
Bengal	65	69	75	83	84	84	83	83	83	80	73	66
Madras, S.-E.	76	79	83	86	88	87	85	84	83	81	79	76

In the above table, in the Punjab from February to May there is a rise of 30° F. and a similar fall from September to December. But from June to September there is a change of only 8° F. In the other two cases also the same tendency is present.

This feature of temperature distribution has a great significance for crop production in India. The uniformly high temperatures during the period of the greatest rainfall are of great benefit for the quick growth and maturity of the Summer or KHARIF crops. The low stocks of food, which the Indian peasant usually has about this period of the year, are thus quickly replenished. The sudden change from summer to winter enables the cultivator to sow the winter or RABI crops while the ground moisture received during the rainy season has not dried up, and is still avail-

able for the germination of the crops. The sudden change from winter to summer, however, proves disadvantageous for the best maturity of crops.

Rainfall Distribution

The Monsoon rains in India are often marked by the following four important variations from the normal:—

1. The beginning of the rains may be delayed considerably over the whole or a large part of the country.
2. There may be prolonged breaks of rain lasting over the greater part of July or August when the summer crops needing plenty of moisture are just growing.
3. The rains may end considerably earlier than usual, causing damage to standing crops and making the sowing of winter crops difficult.
4. The rains may persist more than usual in one part of the country and desist from another part.

The summer rainfall in India comes in heavy downpours leading to a considerable run-off. This results in extensive soil-leaching and soil-erosion. London's 24 inches of annual rain, for example, come in 161 days in light drizzles leading to considerable sinking of rain water, while Bombay's 72 inches come in 75 days only, causing large proportion of the rain water to run off in torrents.

It will be realised that the alternation of a wet and a dry period is the fundamental feature of Indian climate. Owing to this alternation, the significance attaching to a rainfall distribution is naturally great in a hot country like India, whose life depends mostly upon agriculture. The maps in Fig. 7 show that over the greater part of the country MOST OF THE RAINFALL COMES DURING THE PERIOD FROM JUNE TO OCTOBER. The months of November and December are important for rainfall only along the eastern coast of Madras and Orissa. During January and February, however, there is a small amount of rainfall from winter depressions in the Punjab and the Indo-Gangetic valley generally.

Fig. 6 shows that the two areas of the HEAVIEST RAINFALL in India are :—

(I) the western slopes of the Western Ghats mountains.

and (II) the southern slopes of the Assam hills and the eastern Himalayas. The rainfall here is more than 100″ annually. The two areas of the SCANTIEST RAINFALL are :—

(I) the Thar desert and Sind.

and (II) a small part of Orissa. The annual rainfall here is less than 10.″

Over the rest of the country the rainfall generally varies from 20″ to 80″. The areas near the coast and those near the Himalayas have more rainfall than areas away from these two locations.

The following map shows that large areas in India and Pakistan are subject to a considerable variability of

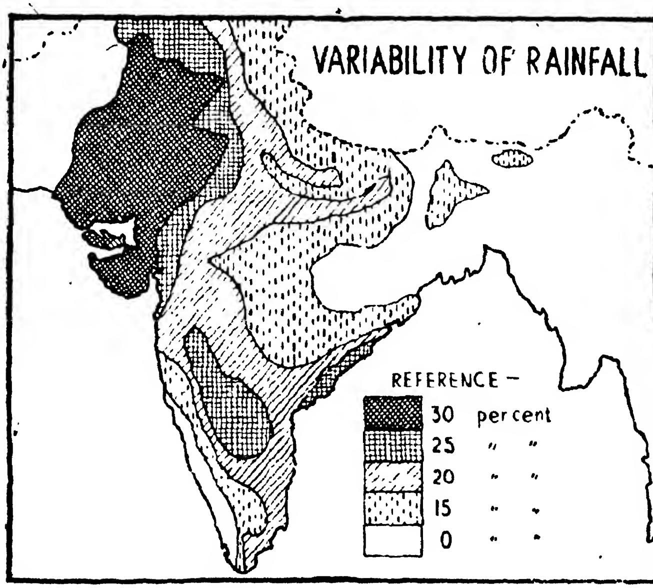

Fig. 8. After Williamson.

rainfall. The map shows that places with lower average rainfall have higher variability. Thus, Naushehra, in

Sind, with a mean annual rainfall of 5 inches has a variability of 53 per cent. But Kanpur whose annual average is 34 inches has a variability of 20 per cent only. Calcutta, with its 65 inches, has only 11 per cent variability. The high variability in areas of low rainfall is, however, not such a serious menace to agriculture as the comparatively low variability in areas which have just enough rainfall for agricultural purposes. Any decrease in rainfall in such areas makes it impossible for agricultural operations to be carried on and a famine is the result.

The failures or variability of rain is not minded either by areas of heaviest rainfall or by areas of lowest rainfall. In areas of heaviest rain, there is always enough water available for the growing of some crops. In the dry areas, there is provision of a network of canals for irrigation that enable the crops to be grown. But other areas are hit severely. Such areas lie in the central part of the country, receiving from 30″ to 50″ of rainfall in normal years. This is the 'FAMINE ZONE' of India. In this area there is enough rain for crops during normal years, so that adequate provision of irrigation facilities does not exist. This fact is the source of considerable suffering in times of drought.

In a very general way, it may be said that the climate of India is a Monsoon climate ; having land winds blowing in winter and the early summer, and oceanic winds blowing in late summer. The late summer is, consequently, the RAINY SEASON. The rain-giving monsoon is known as the S.-W. Monsoon. It is divided into two branches, the Arabian sea branch and the Bay of Bengal branch, because of the shape of the peninsula. The Bay of Bengal branch is forced into the interior of the country by the particular type of relief features. These features are the general direction of the mountains, which almost confine the monsoon into India, and the river valleys like the Ganga Valley and the Mahanadi Valley up which the cyclones from the Bay of Bengal move. These cyclones

are formed, because of the junction of the continental air of India and the oceanic air of the Bay of Bengal. They have a very great influence on the distribution of rainfall in India. The Arabian sea branch of the S.-W. Monsoon practically exhausts itsalf against the Western Ghats. Its influence on the general distribution of rainfall in India is nominal.

The rainfall distribution in India is marked by a region of heavy rainfall along the windward slopes of mountains where the rainfall is more than 100 inches. It is also marked by a north-south running belt of moderate rainfall of 30 to 40 inches per year occupying the central part of the country. To the east of this belt upto the mountains the rainfall is about 50 to 60 inches. To the west of the belt the rainfall is less than 30 inches, except along the western Ghats. The deserts of Thar and Rajasthan have less than 10 inches of rain. The importance of the winter cyclones for rain is also to be noted. Famines are an inborn character of Indian rainfall.

The temperature distribution in India is primarily the function of the latitude. The Tropic of Cancer passes through India. Low temperatures do not occur, as a rule here, except in winter in the Himalayas. There is also a distinction between the temperatures of the Peninsular region and those of the northern parts. In winter, the temperatures in northern India are about 60° F. In the peninsular region, they are above 75° F. In summer, the temperatures in the north are very high in the early part, but they come down to about 90° after the rains start. In the South the summer temperatures are about 90°. The character of the night temperatures is a distinctive feature in the plateau region of the south. Even in summer, the nights are cool and breezy on the plateau.

Monsoon Forecasts

The strength of the summer monsoons in India depends on four factors. These are :—

(i) The amount of snow that has accumulated in the Himalayas by the end of May. If this amount is

large, the monsoons tend to be weak, specially in the North-western part of the country.

(ii) THE AIR PRESSURE IN MAURITIUS in the month of May, which typifies the air pressure over the Indian ocean. If this pressure is high, the monsoon is weak. For it tends to create anticyclonic conditions in India.

(iii) THE RAINFALL IN EAST AFRICA AND IN ZANZIBAR during April and May which is an index of the air currents in the equatorial doldrums. If this rainfall is high, the Indian monsoon is weak. For high rainfall in the doldrums can result only when the convectional currents of air are considerable. Such currents retard the flow of air from the South Indian Ocean into India.

(iv) THE AIR PRESSURE IN CHILE in South America during the months of March, April and May. If this pressure is high, the Indian monsoon is good. For it tends to create low pressure in the Indian Ocean and so the cyclonic conditions in India.

EFFECT ON ECONOMIC LIFE

India's climate has several important features that affect her economic life.

(i) The temperatures are never too low in winter in any part of India. This gives a long growing period, especially as the frost is practically unknown, except locally now and then. This feature enables India to grow temperate land crops during winter and tropical and sub-tropical crops during summer. In fact, but for the two driest months, May and June, the whole year is the growing season in India. In Bengal, Assam and the Peninsular region, wherever water is available for irrigation even in these dry months crops are growing in the fields. Thus, as many as three crops of rice can be grown in one year in these parts.

(ii) The largest amount of rain comes during the three summer months, June, July and August. This is utilised for the quick maturing food crops like millets.

and maize, etc. The hot and moist climate of this period produces an abundant vegetative growth in the plants which is useful in providing plenty of fodder for cattle.

(iii) The summer temperatures are high and rise suddenly. The maturity of crops in India is, therefore, rapid. This rapid maturity of crops tends to deteriorate their quality. India is, therefore, not a 'quality' producer, but only a 'quantity' producer. This applies to winter crops as well as summer crops. For the harvesting period of both occurs during summer.

(iv) The concentration of rainfall to a few months in the year leaves the greater part of the year as dry. This does not encourage the growth of grasslands in India. Whatever grass grows during the rains is scorched during the dry season. Pasturage is, therefore, poor in India. Cattle and other stock have to be stall-fed.

(v) The geographical distribution of rain in India is such that areas of fertile alluvial soil (in the Punjab and U. P.) where the winter temperatures are cool enough for temperate land crops get only a moderate amount of rain, about 30 inches. This enables them to grow a large amount of wheat.

(vi) The huge rainfall, coming immediately after the country has experienced great heat of summer, breeds many disease germs. Malaria, dysentery and a host of other diseases afflict the population during and after the rains. This saps the vitality of the people living in the wetter parts of the country.

(vii) The hot and moist climate of the summer months not only tells on our health, but also tends to make us easy-going. In contrast, the people in the temperate lands are forced to be active physically to keep them warm. This climatic drawback makes labour in India inefficient. This drawback, however, does not affect all parts of India to the same degree. The Punjabi, brought up in a dry climate, is entirely different from the Bengali living in a hot and moist climate.

(viii) The frequent failures of rain and the attendant misery and starvation facing millions engaged in agriculture have tended to make people superstitious. They easily lose heart and feel helpless against 'Fate'.

QUESTIONS

1. What do you understand by 'Monsoon Climate? On what factors does it depend?

2. Why is the study of the climate of India necessary for understanding its economic geography?

3. Discuss the pressure conditions in South-eastern Asia in May. What is their effect on the weather conditions of India?

4. What are the characteristics of Indian rainfall? Discuss them carefully.

5. What is the significance of winter cyclones in Indian climate?

6. Why is the distribution of rainfall all over India not uniform?

7. It is said that the Indian Budget is a "gamble in Monsoon". Do you agree with this statement? Why?

8. What causes affect the distribution of Temperature in India during (*a*) Winter and (*b*) Summer?

9. Describe the factors that enter into the forecasts of Indian Monsoons.

CHAPTER II

PHYSICAL FEATURES

The core of the physical structure of India is the Peninsular India. The Peninsular part is the oldest, while all other parts were formed around it at a later period. It is of interest to note that ever since the formation of the earth's crust, Peninsular India has always remained a land area, never having been submerged beneath the sea except locally and, that too, temporarily. The only structural changes that have taken place here, therefore, have been of the nature of faults or fractures in the crust due to tension. The mountains found in the Peninsula are, therefore, mostly of the "relict" type. They are not true mountains of upheaval, but are mere outstanding portions of the surface that have escaped the weathering of ages that has removed the surrounding parts of the land. Due to its old age one encounters, not the 'youthful', as is characteristic of other regions of India, but 'mature' relief in the Peninsula. Its rivers have flat shallow valleys, with low gradients, because their channels have approached the 'grade or the base-level of erosion.'

Geological History

There are two periods in the geological history of India which are landmarks in the physical features of the Peninsular India. The first period is that when, owing to earth movements, numerous cracks and fissures were made in the surface and large linear tracts subsided. This gave rise to basin-shaped depressions. The drainage of the land discharging its sediments into these depressions ultimately filled them up. These sediments later hardened into rocks known in Geology as the 'Gondwana' rocks, from the typical deposits of these rocks occurring in the Gond country to the south of the Narbada. Beneath this debris was buried the luxuriant vegetation which was

later converted into thick seams of coal, in some parts 20 to 80 feet thick. There is evidence enough to support the geologists in their conclusion that at this period of the geological history of India the Peninsular India was connected with such far-off countries as Australia, South Africa and Patagonia. It was during this period that the large deposits of sandstone found in the Mahadeo and other hills of the Satpura range were made.

The second outstanding period is that when the Deccan experienced intense volcanic activity. A large area of the Peninsula was flooded by quiet outpourings of lava from fissures in the earth's surface. The lava eventually raised the greater part of the Peninsular India into a plateau. Denudation has now cut this plateau into numerous isolated, flat-topped and square-sided hill masses, so characteristic of the Western Ghats.

The parts north and east of the Peninsula have had a chequered history. They have been buried under the sea several times. This sea was an extension of the Mediterranean Sea and extended at one time up to the south-west corner of China. The geologists call it the Tethys. The mighty Himalayas have been formed from marine deposits in that sea. After the Deccan had been covered with large deposits of lava, it appears that considerable earth forces were released which gradually crumpled and folded the marine deposits of the Tethys into the loftiest mountain of the world, the Himalayas. The sea receded to the west, giving place to an estuary of the combined Indus-Ganges-Brahmaputra river system. The drainage from the newly created Himalayas carried with it immense quantities of debris which quickly filled up this estuary. The forces of upheaval continued and this deposit of the rivers was folded into the Siwaliks near the foot of the Himalayas.

The earth forces involved in the upheaval of the Himalayas produced a depression to the north of the Peninsula. This wide trough between the Peninsula and the Himalayas was occupied for some time by an arm

of the sea. It was in this trough, therefore, that the drainage from these two areas emptied itself. This drainage was disturbed in later times by unequal earth forces which dismembered the old river system into the three separate river systems of the Indus, the Ganges and the Brahmaputra. The depression which was still left, began to be filled up by the silt brought down from the high ground by the numerous tributaries of the Indus and the Ganges. Each fresh uplift of the mountains must have rejuvenated these streams. This must have multiplied their cutting and carrying capacity, and so quickly filled up the Indo-Gangetic depression. The depth of the alluvium in the Indo-Gangetic depression is tremendous. It is estimated from 6,500 feet to 15,000 feet. The trough is not of uniform depth along its whole length; it is probably at its maximum between Delhi and the Rajmahal hills, and shallowest in Rajputana and Assam.

Some geologists, however, believe that the Indo-Gangetic Basin occupies not a trough created during the folding of the Himalayas, but a fault valley of the type of the present Narbada valley, which must have been filled up completely by the tremendous amount of silt brought down from the Himalayas. The great depth of the silt deposits must be hiding the steep sides of the fault valley.

The forces of upheaval are still at work in the Himalayas. The northern-rim of the trough, where it merges into the Himalayan foot-hill zone is one of considerable tectonic strain. The earthquake zone of India runs along the northern edge of this trough.

PHYSICAL DIVISIONS

Based upon this geological history, India is divided into the following four physical divisions. In these divisions, the fundamental importance of the Deccan Plateau and of the Himalayas is to be noted. It is ALONG these regions that the plains of India, which are so impor-

tant economically; have been formed. These physical divisions are :—

1. The Himalayas and the adjacent mountains :
2. The Southern Plateau ;
3. The Coastal Plains ;
4. The Indo-Gangetic Plains.

1. THE HIMALAYAS

The mountain mass that bounds India on the land border of Asia consists of a number of mountain ranges among which the Himalayas are the most famous. The Indus and the Brahmaputra rivers divide this mountain mass into three sections : (i) the Himalayas, (ii) the mountains lying to the north-west of the Himalayas, and (iii) the mountains lying to the south-east of the Himalayas. Between the Indo-Gangetic plain and the main mountain mass lie minor ranges like the Salt Range and the Siwaliks. Enclosed behind these minor ranges are high plains which are known in some parts as 'Dun plains'.

The Himalayas are a range of folded mountains which are among the youngest in the world : because of their youth they have the highest peak in the world. Mount Everest (29,141 ft.), Kinchinjunga (27,815 ft.) Dhavalagir (26,826 ft.), are the highest peaks. These may be compared with Mt. Mckinley (23,100 ft.), the highest peak in the Rockies in North America, Aconcagua (23,000 ft.), the highest peak in the Andes in South America, and Mont Blanc (15,781 ft.), the highest peak in the Alps. There are more than 140 peaks in the Himalayas which are higher than Mont Blanc, the highest peak of the Alps. The economic significance of the great height of the Himalayas has been noticed elsewhere in this book where it has been noted how the Himalayas have acted as a climatic barrier by keeping the Monsoons in and shutting the cold northerly winds away from India, and as commercial and social barrier because of their very high passes. The average height of the passes in the Himalayas is between 16,000 and 18,000 feet which easily exhausts both man and beast.

Compare this with some of the important passes in the Alps. The Brenner pass between Italy and Austria is 4,484 feet. The Simplon, between Italy and Switzerland, is 6,592 feet high, and the Mont Cenis pass, between Italy and France is 6,850 feet.

The Himalayas proper extend for about 1,500 miles between the rivers Indus and the Brahmaputra. The average breadth of the country over which they spread, is about 150 miles. Over this vast extent, ridges and valleys occur in almost all directions. The main folds, however, all run along the Tibetan Plateau. In the north-western section, therefore, the general trend of the valleys is east-west, and in the eastern section it is north-south. There is no continuous valley to separate the main range from the minor ones. Owing to their youth the Himalayan valleys are mostly V-shaped narrow gorges in which the streams are cutting backwards, so that river and valley capture is a very common feature in the Himalayas. Some U-shaped glaciated valleys also occur at great elevations where the glaciers descend from the mountains.

The Great Himalayan Range, running from the Indus to the Brahmaputra, is characterised by great elevations which remain covered under perpetual snow. The highest peaks of the Himalayas occur in this range. Both towards the Tibetan side and towards the Indo-Gangetic plain side of this Himalayan range are found ranges of lower elevations. Examples of such ranges are, on the Tibetan side, the Ladakh range and the Zaskar range, and on the plain side, the Pir Panjal range. The spurs and ridges of these, as well as the main range run in all directions and present to the eye a confusing mass of hills and valleys. Of these valleys and valley slopes those of the big rivers draining into the plains alone are important from the economic point of view. Most of these valleys, though narrow, have their sloping walls composed of limestone which usually yields a fertile soil.

Enclosed within the Great Himalayan Range and the minor southern ranges are two broad valleys which are

not strictly speaking 'river valleys.' They are Katmandu and the famous vale of Kashmir. These are vast plains situated at about five thousand feet above sea level and enclosed by mountains on all sides. The origin of these may have been the silting up of great lakes, the evidence of which may be found, in the case of Kashmir, in the remnants, the Wular Lake and the two Dals near Srinagar.

The latest to be added to the family of the Himalayas are the Siwalik Hills which are not a continuous range like the Himalayas or the other ranges near it. They are not so high either; they are a mere two-to-three-thousand feet as compared with the staggering heights of the Himalayas ranging in the neighbourhood of 28,000 ft. These hills have been made out of the debris coming from the Himalayas. The proportion of mud, therefore, predominates in these hills, which accounts for the particularly green aspect of the Siwaliks. These hills are found only in the middle section of the Himalayas. They are absent in its north-western and eastern sections. The Siwaliks are given different names in some parts, for example, near Gorakhpur they are known as Dundwa Range and further east as Churia Range.

Between the Siwaliks and the Himalayas there are some flat valleys known in some parts as 'Doons.' Hence the name Dehradun. The 'Doons' are covered with deep deposits of silt and rock brought down by the swift flowing rivers from the Himalayas. These rivers, in most cases, are obstructed in their course by the Siwaliks. They, therefore, deposit a considerable part of their load in the plains lying between the foothills of the Himalayas and the Siwaliks. Here and there in these 'Doons' jut out the tops of hillocks that have been buried under the silt. Usually these tops are well-wooded. In most cases rivers cross the Siwalik hills through deep gorges, but in some cases large rivers also flow out through the gaps, naturally provided by the occurrence of these hills in sections.

Towards the north-west beyond the Indus, the Himalayas are succeeded by the mountainous country of

Baltistan which is not politically in India. The Karakoram and the Hindukush mountains dominate this part. This mountainous country continues westwards into the tribal homes of the border tribes living between Pakistan and Afghanistan. The Sulaiman and the Kirthar ranges separate this hilly country part of which lies in the North-Western Frontier Province and in Baluchistan, from the

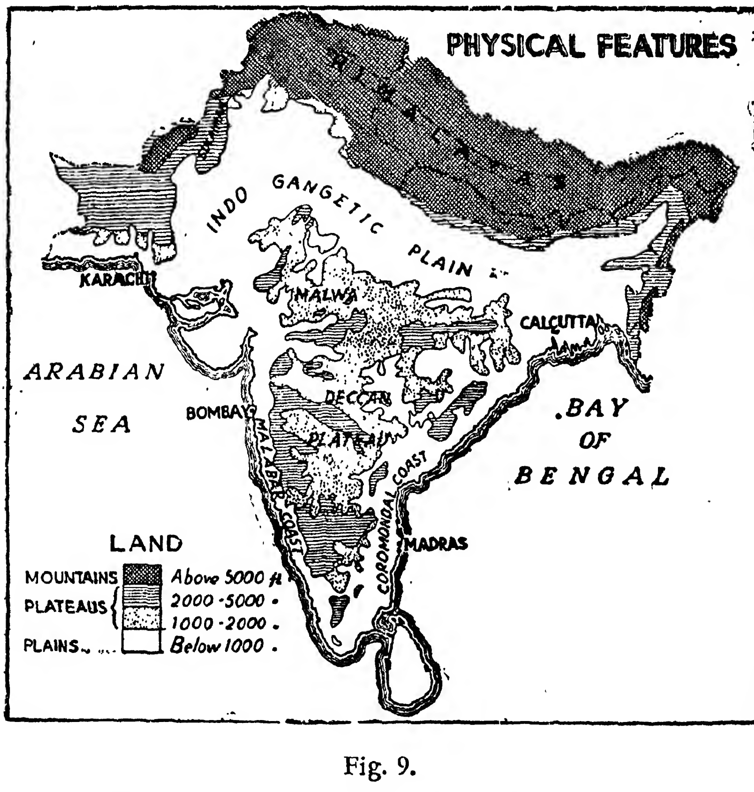

Fig. 9.

Indus Plains. Separated from the Indus plains by the Sulaiman Range are almost hill-girdled plains of Peshawar, Kohat and Bannu situated at an altitude of more than a thousand feet. These plains are similar to the 'Dun' plains found between the Siwaliks and the Himalayas in India ; the place of the Siwaliks being taken by the Salt Range to the south of the Peshawar plain in Pakistan.

The slope of the mountains is steep towards the Indus plains and communication is possible only through the mountain passes that follow one or other stream crossing these mountains from Afghanistan side. The most important of these passes is the Khyber pass that follows the Kabul river which is the biggest river coming from across these mountains. These passes are situated at about six thousand feet above sea-level and are not so difficult to cross as the high Himalayan passes.

The direction of valleys in this hilly region is generally from north-east to south-west, which further west in Makran becomes east-west. As one proceeds away from the Himalayas in this hilly country, the climate becomes drier and drier. The land forms are, therefore, more and more the result of wind erosion. Alluvial deposits are less marked. Stony ground predominates.

Towards the east, the Brahmaputra breaks the continuity of the Himalayas into the adjoining hills of Burma and Assam. These hills are not so high as the Himalayas or even those on the North-Western Frontier in Pakistan. There are no broad valleys in these hills. The Garo, Khasi, Jaintia, and the Naga hills, running almost east-west, join the chain of the Lushai and the Arakan hills running north-south. Towards the plains these hills generally present a steep slope. Towards the interior of this hilly region the slope is gradual and there are some plateaus broken by low hills. One such plateau is the plateau of Shillong. In the south, in some places the hills have receded a little giving the shape of a funnel. Cherrapunji (Fig. 5) which has got the distinction of having about the largest rainfall in the world, is situated in one of these funnels. The plains in the neighbourhood of these hills are generally swampy due both to the heavy rainfall and a flat muddy surface which retards quick drainage.

All along the Himalayas and other hilly regions where they join the plains, there are 'forelands' known locally as 'bhabar' or 'ghar' in which are deposited coarse sands and pebbles brought down from the hills by the swift

flowing mountain streams. Except during the rainy season these areas are marked by dry river courses in which the water of the smaller streams sinks underground. It is only the larger rivers that flow on the surface in the bhabar area. These bhabar lands are more extensive in the western and north-western hilly region than in the east.

The water that sinks underground in the bhabar reappears on the surface where the plains begin. This water converts large areas along the wetter parts of the hilly regions into 'swamps' or 'terai' which is usually an ill-drained, densely forested plain. The terai is more marked in the eastern regions, due to greater rainfall than in the west.

Southern Plateau

The Peninsular Region which is the oldest part of India, is divided into several large or small plateaus, about 2,000 ft. above sea level. The dividing line is formed by low hills, which are either the remnants of old mountain systems, as in the case of the Aravalli Hills, or the harder parts of the plateau itself which have withstood erosion, as in the ease of the Western Ghats. The interiors of the plateaus are marked by a number of rivers which flow in broad, flat valleys. The fringes are considerably broken. On the top, the surface of the plateau is hummocky or undulating. A number of isolated hillocks are also found in the interiors, but they are more numerous near the hills bounding the plateaus.

The fault or the rift, in which the Narbada river flows, divides the Plateau Region into two almost triangular portions. The northern portion is known as the Malwa Plateau. To the west and north-west of the Malwa Plateau are the Aravalli Hills which occupy a considerable east-west expanse. They narrow down considerably towards the north-east where they degenerate into low hillocks which finally end near Delhi. The Aravallis are crossed by a number of rivers which are dry except during the rainy season. Important among

them are the Banas, the Mahe, and the Luni flowing into Arabian Sea, and the Chambal flowing into the Jamuna in the Ganga valley. The highest elevations occur in the north-eastern section in the isolated blocks, where Mount Abu records the highest point, 5,653 feet above sea level.

In Rajasthan the vicinity of the Aravallis is marked by patches of stony ground which are evidence of the long time during which erosion has been going on in the Aravalli area. It has already been noted that the Aravallis are the remnants of the oldest mountain system of India.

Towards the south, the Malwa plateau is bounded by the Vindhyas which are given the high-sounding name of 'Mountains', though in reality they are nothing more than the escarpment of a rift valley. Running east-west along the Narbada valley, the Vindhyas join the Kaimur Range which is a similar escarpment along the Son valley. Towards the north-eastern corner of the Malwa Plateau are the Bundi hills. The Malwa plateau, like the other plateaus in the south, is largely broken in the neighbourhood of rivers or where it approaches the Ganga Valley. These broken areas are called 'ravine land.' Examples of these ravine lands are found in the highly broken country of Bundelkhand and in the valleys of the Chambal and the Banas. In the interior the surface is flat, except where isolated low hillocks occur. The slope of the greater part of the Malwa plateau is towards the Gangetic valley.

The country south of the Narbada is called 'the Deccan' tableland. It is also triangular in shape and bounded by low hills on all sides. Towards the north are the Satpura hills whose highest point is in the Mahadeo Hills, on which is situated Pachmarhi, the summer seat of the M. P. Government. These hills continue towards the east where they meet in the Amarkantak, the hills of the Chhota Nagpur plateau. There are various local names given to the hills. One distinct feature of the Satpuras and other hills of the Deccan tableland is

that unlike the Himalayas, they have no conical 'peaks', they have 'flat tops' or small tablelands as their highest point. The Satpuras have experienced in the past much faulting, as a result of which practically all the rivers in it flow in deep gorges. The gorges are big or small according to the size of the rivers which have considerably modified these gorges. The descent of these rivers from the higher plateau is by means of falls, as in the case of the Narbada near Jabalpur. Towards the north of the Satpura lies the flat valley of the Narbada and towards the south that of the Tapti. The flat plains of the Narbada and the Tapti lie in the region of the 'regur' or the 'lava soil' in which the rounded tops of a few hillocks buried under the deep lava deposits protrude here and there. The rivers Narbada and Tapti flow against the general slope of the tableland due to their situation in deep rift valleys running east to west.

The western flank of the Deccan tableland is guarded by the Western Ghats, a portion of them is also called the Sehyadari hills. Their steep slope is towards the sea. The wall-like slope of the Western Ghats towards the Arabian Sea is a clear indication of faulting which seem to have separated the Peninsula of India from the land that now lies buried under the Arabian Sea. The Western Ghats are a continuous mass running north-south, across which access is possible only through a few gaps or low passes. In two of the passes, the Bhor Ghat and the Thal Ghat, access is through tunnels. Except near their northern and the southern extremities, the Western Ghats run close to the sea leaving only a very narrow coastal strip. Where they are very close to the sea, rocks jut out into the sea making navigation risky. Only a few rivers have been able to cut their course across these hills; they all flow through very deep gorges along which communication is impossible. There are many rivers that take their rise on the western slope and many others on the eastern slope. Those on the west have a shorter distance to the sea and are, therefore, swift-flowing, with small alluvial fans near their mouth. Those on the east have longer and, in their

lower courses, wider valleys with big deltas near their mouth. Usually there are big falls where these rivers descend from the Ghats to the plateau to the east or the coastal plain to the west.

Towards the east of the tableland are the Eastern Ghats which are a contrast to the Western Ghats just described. The eastern Ghats are a series of low hillocks separated from one another by wide gaps usually occupied by rivers coming from the Western Ghats or the Satpuras. It is only in the extreme south where they join the Nilgiri hills that they are continuous for some distance. The Eastern Ghats are the remnants of very old fold mountains like the Aravallis. They are unlike the Western Ghats which are an escarpment of the Plateau. They do not rank with the Western Ghats in height or steepness of slope. Towards the north-east, the Eastern Ghats join the hills of the Chhota Nagpur plateau. Throughout their extent the Eastern Ghats keep away from the sea, thus leaving a broad coastal strip. It is only near the Chilka Lake that they approach closest to the sea. The Eastern Ghats are joined to the Western Ghats through the Nilgiris, and to the Satpuras through the Chhota Nagpur hills, thus completing the triangular boundary of the tableland.

South of the Nilgiris lie the Anaimalai Hills which are separated from the former by the Palghat Gap. This gap is about 20 miles broad and provides easy access between the west and the east coast of India. A branch of the Anaimalai runs to the north-east under the name of Palni Hills. Another branch runs to the south as the Cardammon Hills. The latter continue right up to the southern extremity.

Thus, the physical features of the Peninsular India have resulted partly from the very old mountain systems that remain exposed above the vast lava deposits, and partly from the lava deposits themselves that buried the old rocks to a great thickness converting the major part of the Peninsula into a big tableland or plateau.

The remnants of the old mountain systems in the Peninsula are the Aravalli, the Satpura and the Eastern Ghats. These are mostly disconnected hills with rounded or flat peaks. Their elevation is generally low. They are formed largely of old sandstone, though limestone and shales are also of common occurrence in them. The Peninsular region of India has experienced a good deal of 'faulting' in the past. Owing to this faulting several large 'rift valleys' have been formed. Some of these rift valleys are now occupied by rivers, e. g., the Narbada and the Tapti rivers. The result of this faulting has been that the big plateau of the Peninsula has been divided into a number of smaller plateaus; like the Malwa plateau, the Deccan tableland, the Chhota Nagpur plateau, and the Mysore plateau, etc. The escarpments facing the valleys that separate these smaller plateaus are considerably broken up into ravines, due to the erosive action of running water. They therefore, look like hills when seen from the valley itself. The Vindhyas, the Kaimurs and the Bundi Hills are examples of such dissected escarpments.

The highest peak of the Nilgiris, Dodabetta, is over 8,640 ft; of the Anaimalai the highest peak is Anaimudi, over 8,800 ft. These mountains are the continuation of the Eastern Ghat mountains.

The tops of the plateaus are seldom flat. They are generally hummocky or undulating. Here and there, stand a few hillocks which are the evidence of the harder parts of the plateau, resisting erosion for long. Some of these hillocks, like the Fort rock of Gwalior, are the examples of 'circum-erosional mountains' which stand out above the surrounding country, because the softer rocks around them have been washed away. The rivers that flow in these plateaus have cut for themselves deep and broad valleys, with almost flat bottoms. Where these rivers leave the plateau, there are generally waterfalls or rapids.

The most conspicuous feature of the Peninsula is, however, provided by the Western Ghats. They are a

considerably eroded escarpment of the lava plateau facing the Arabian Sea.

To state very generally, the Peninsular India is marked by old and hard rocks which are mainly metamorphosed rocks like the Dharwar rocks; igneous rocks like the granites and basalts that usually occur as loose isolated blocks; and old sedimentary rocks like the sandstones and limestones. The basalt rock also occurs as a black thin layer on the tops of hills.

The rocks of the Peninsula have suffered long denudation. This part of India, therefore, tends to be a plateau, as the elevations have been worn down. The lava deposit over a large section to a great depth also made it a plateau.

The Peninsular region was also subjected to a considerable amount of faulting. These faults occur in various parts of the region. The fault of the Narbada and the Great Boundary Fault of the south are examples.

In conclusion it may be said that there is a great variety of physical features in Peninsular India.

3. Coastal Plains

The Southern Plateau is surrounded on all sides by low plains. It is against the hard rocks of the plateau that the plains have been formed. Towards the north is the Sutlej-Gangetic plain; towards the east the Gangetic plain and the eastern coastal plain; towards the south also the eastern coastal plain; and towards the west, the western coastal plain which joins the Thar desert plains.

The eastern coastal plain, which is known as the Payanghat, may be considered in two sections: the lower section which consists of the deltas of the rivers; and the upper section which consists mostly of the plains lying in the upper courses of the rivers. The lower section is entirely alluvial, while the upper section is partly alluvial and partly a PENEPLAIN formed by the denudation of elevated relief. This peneplain is covered

in some places by thin alluvium of the river, while elsewhere old rocks still stand out prominently. The lower section is fringed by a series of sand dunes in the vicinity of the sea. These sand dunes have been formed by the action of waves. In some parts enclosed within these sand dunes are lagoons. The lakes Pulicut and Chilka are in reality big lagoons of this type. Immediately along the sea a sandy beach stretches all along the sea coast. The Payanghat extends through the Palghat gap to the western coastal plain.

The western coastal plain, beginning from the Malabar coast, runs from the south to the north all along the Arabian Sea. Towards the south the plain is very narrow, except where the Western Ghats have receded. The southern section is also characterised by a number of long and narrow lagoons which are navigable for hundreds of miles. These lagoons are unlike those found on the eastern coast in this respect, because the latter are generally surf-beaten and shallow. The western coastal plain broadens to the north of Bombay into the alluvial plains of the Tapti and the Narbada, and further north into Gujarat. Part of the coastal plain in Gujarat and Kathiawar, as well as in Cutch, is also a PENEPLAIN where the old rocks still appear on the surface. Gujarat and Kathiawar plains are partly covered by the regur of the Black Cotton Soil.

The western coastal plains merge in the extreme north into the Thar and Rajputana deserts. These parts are characterised by vast deposits of sand or silt, partly due to the dry old river courses and partly to the emergence of vast plains from under the sea which is receding in this part.

The Thar and Rajputana deserts, in their western and northern sections are marked by sand dunes covering hundreds of square miles of area. These sand dunes are due generally to the blowing in of sand from the neighbouring dry plains by the prevailing winds.

THE SUTLEJ-GANGA PLAINS

The Sutlej-Ganga plains appear flat with a gentle slope away from the Himalayas. For miles together they show no relief features. On closer examination, however, they are found to be cut up into a number of lowlands and uplands formed by the numerous rivers coming from the Himalayas. The older alluvium deposited by the rivers forms the uplands which are known locally as 'Bangar', and the newer alluvium in the river-beds forms the lowlands or 'Khadir'. The older and the newer alluviums are separated from each other by the high river banks which are in some cases as high as one hundred feet from the river-bed. The uplands in the neighbourhood of rivers are broken into extensive ravine lands, extending for miles on both sides of the rivers. The ravine lands are like the 'bad lands' of North American Western plains and have suffered considerably from soil erosion due to reckless destruction of vegetation cover of the soil.

The lowlands and depressions become more prominent as one approaches the delta of the Ganga. The Ganga Delta is the largest delta in the world, having an area of about 31,880 sq. miles. A large number of the depressions in the lower section of the Ganga plain are old river beds which have been cut off by a change in the river course. These depressions are called locally the 'bils'; while the river banks are called 'Chars'. The significance of the 'Chars' is very great in the location of villages in the delta region where the depressions are entirely flooded during the rainy season.

It should be noted that no part of the Indo-Gangetic plain is a PENEPLAIN.

QUESTIONS

1. What is the economic significance of the Himalayas?
2. How do the Siwaliks differ from the Himalayas? What is their economic significance?
3. What is a 'Doon'? What are its physical characteristics?

4. How do the valleys of the Deccan tableland differ from those of the Himalayas? What is the economic significance of this difference?

5. What are the physical characteristics of the Indo-Gangetic plains?

6. What is meant by 'ravine lands'? Where do they occur most in India? Why?

7. How do the Payanghat plains differ from the Indo-Gangetic plains? Does this difference in any way affect the agriculture of the two plains? How?

8. Describe the main features of the Eastern Ghats and say how they affect the lines of communications.

9. What are the physical characteristics of the West-Coast plains? Account for them.

10. What are the characteristics of the Aravalli Hills? How do they contrast with the Vindhyas?

CHAPTER III

VEGETATION

There is a great variety in the natural vegetation of India. Considering the great variations in climate and physical features of the country, this is to be expected. Tropical, Sub-tropical, Temperate and Alpine; all classes of vegetation occur in this country.

Tropical Vegetation

Over the greater part of the country, however, it is the tropical vegetation that is found. Ordinarily, in other parts of the world, tropical vegetation is subdivided on a basis of moisture conditions into the following types :—

(a) Evergreen forest; (b) deciduous forest; (c) savannah; (d) thorn forest; and (e) Steppe.

In India, however, according to Champion*, examples of well-defined tropical grasslands are lacking; though grassland is common enough as a secondary and a temporary phase of development under the influence of forest fire or grazing. The typical savannah type of other countries is also absent, as the closed deciduous forests here grade into thorn forest without any open grassy park-like stage.

Sub-Tropical Vegetation

The Sub-tropical, Temperate or Alpine vegetation is found in India only on the mountains. The sub-tropical conditions seem to be determined more by altitude than by latitude here and are characteristically developed in the hilly tracts. The Sub-tropical Zone is really a transition from the tropical to the temperate Zone, and is sometimes, difficult to be distinguished. Owing to a moderate summer monsoon rainfall, it seems quite well

*Champion : A Preliminary Survey of the Forest Types of India and Burma, 1936.

defined in the West and Central Himalayas as the CHIR Pine Forest. In the north-west also where the rainfall is low and comes mostly in winter, there is a sub-tropical dry evergreen forest. Even in the Eastern Himalayas where there is a heavier summer rainfall, the sub-tropical belt of forest occurs between the tropical vegetation and the temperate oak forests. But on the hills of South-India there seems to be no real break between the tropical and the temperate types; only a falling off in the luxuriance of forest being noticed. The small daily and seasonal range of temperature is evidently the cause of this there.

Temperate Vegetation

The temperate vegetation in India consists only of forests on mountains. There are no temperate grass-lands in this country, as India does not extend into middle latitudes.

The Temperate forests in India are distinguishable in three classes. Two of them are mainly coniferous, while the third is predominantly broad-leaved. These classes depend mostly upon the rainfall during the season of vegetative activity, i.e., the summer months with a mean temperature over 55° F. The wettest type, which is the broadleaf type, occurs both in the southern and the northern hills, but the moist and dry types, which are coniferous, occur only in the Himalayas.

Alpine Vegetation

The Alpine vegetation is found in India only in the Himalayas and the connected ranges. Above the timber limit, high forest is replaced by Alpine scrub, varying in form with the available moisture supply. The birch and the rhodendron are the commonest trees in the Alpine forests in the Himalayas. The forest is mainly evergreen, although several of the broad-leaved varieties are deciduous. These forests occur at altitudes of 9,500 ft. to 11,500 ft.

VEGETATION OF THE PLAINS

The natural soil covering of the plains in India is a closed forest. But very large areas in the plains are found to be almost, or quite, devoid of trees. They support only a meagre covering of grass. It is extremely probable that clearings for human habitation and agriculture are responsible partly for this. There is, however, another way in which closed forests can be destroyed and replaced by grass. Owing to the alluvial nature of the soil in the plains, the rivers continually swing backwards and forwards in their courses. It often happens that as a result of heavy rainfall in the hills, these rivers rise rapidly and carry down enormous quantities of clay and silt. Should it happen that the flood is of exceptional duration and volume, the rivers spread their waters over a large area. When this happens in evergreen forests, a deposit of clay and silt is laid down which ultimately leads to the decay of the forests. In the following year, in the evergreen forests, most of the tall trees and shrubs die out, owing to the clay deposit. The trees that are left soon disappear, owing to the attacks of fungi and insects. This phenomenon is quite common and is responsible for the destruction of the forest cover over large areas in the plains, close to the foot hills.

Overgrazing and forest fires also lead to the destruction of natural forests. The forest fires in India are most destructive during the cool weather when the grass is not wet and when the atmosphere is dry. During the summer months the grass under-bush withers, while it is soaked during the rainy season and cannot, therefore, carry the fire.

JHUMING

The influence of man in the destruction of forests is most serious. Apart from the reckless cutting that is common to all parts of the world, Indian forests in Assam suffer from the practice of 'Jhuming' which the backward tribes follow to clear the ground for cultivation. Jhum-

ing is practised only between certain altitudes. There is no Jhuming above 8,000 ft. for the reason that crops will not ripen so high. Below 5,000 ft. the hill people do not go, for fear of heat and disease. The south-east, south, or south-west aspects are usually chosen in order to take advantage of the sun's rays, and all trees, even the largest, are cut down in the cold weather. During the hot weather, the debris is set fire to at the lowest part of the jhum; the rising flames cause an upward draught and the fire rushes up the hill. When all is over, nothing is left but the charred and blackened trunks of the largest trees. As soon as the embers have cooled down, various seeds, such as rice, millet, pumpkins, etc., are dribbled into the earth with the ashes. The field is weeded once or twice during the rains before the crop is harvested. Next year and the following year, the field is cultivated and then when the accumulated fertility of the soil has become exhausted, mainly through exposure and erosion, the area is abandoned. A distinctive shrubby vegetation then takes possession of the land, or it may be covered with a weed. In areas where there is a real land hunger, the Jhumias return at shorter intervals to the same field and the inevitable result is that the area does not get a chance to become covered with tree at all.

Forest Types

Broadly speaking Indian forests may be divided into the following main types* :—

1. Arid Forests. These forests extend over a considerable portion of Rajputana, and the south of the Punjab, in dry tracts where the rainfall is less than twenty inches. The number of species in this forest is few; the most important tree being the babul or kikar which, however, in the driest regions exists only by the aid of river inundations.

*Troup: The Work of the Forest Department in India.

2. Deciduous Forests. Most of the trees in this type are leafless for a portion of the year. This type of forest loses its leaves at the beginning of the hot season, when fire normally runs through it and burns the grass layer which is the usual soil covering. The layer of fine soil increases the clay content which increases its water-holding capacity. The species which cannot tolerate the

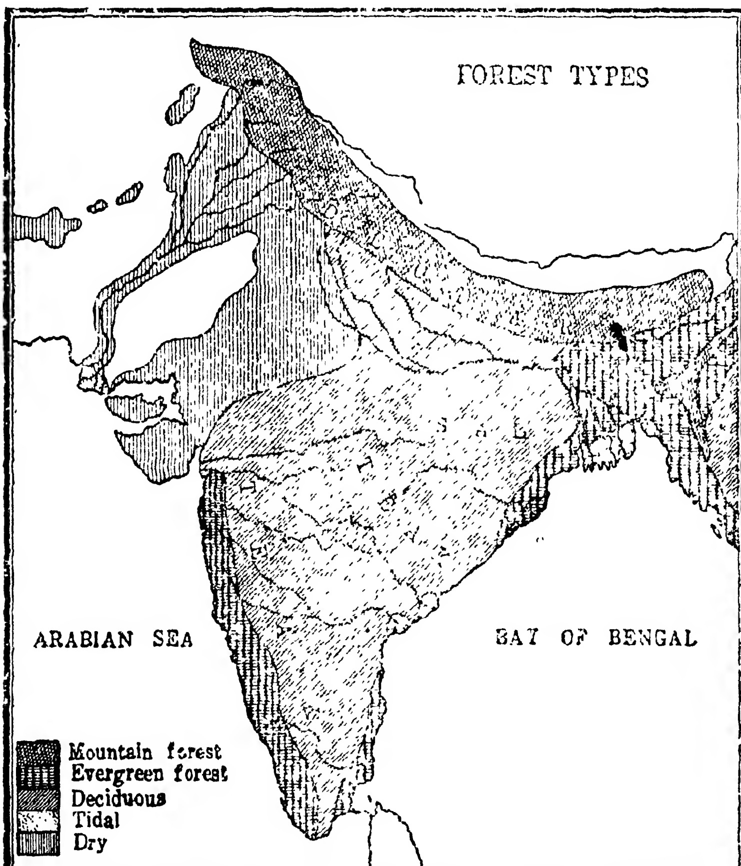

Fig. 10.

early dry conditions which are common in the deciduous forests thus make their appearance. These forests, which extend over large areas in the sub-Himalayan tract and

the Indian Peninsula, are among the most important. They comprise the greater part of the Teak and the Sal forests of India.

3. EVERGREEN FORESTS. These forests occur in regions of very heavy rainfall, such as the west coast of the Peninsula and the eastern sub-Himalayan tract. They are characterised by the great variety and luxuriance of their vegetation. Some of the trees in these forests grow to a height of 150 ft. or more with a dense canopy on top. The undergrowth is often a tangle of canes, creeping bamboo and palms which may replace high forest along streams.

4. MOUNTAIN FORESTS. As has been noticed above, mountain forests vary from the sub-tropical through temperate to Alpine forests, according to elevation and rainfall. In the Eastern Himalayas and Assam these forests are characterised by various kinds of oaks, magnolias and laurels. In Assam 'Khasia pine' grows abundantly at elevation of 3,000 to 7,000 ft. In the North-Western Himalayas, the chief timber tree is the Deodar which occurs most commonly at elevations of 6,000 to 8,000 ft. The Deodar also occurs in association with oaks or blue pine. Towards its upper limit the deodar merges into spruce and silver fir, while below it are found extensive forests of CHIR pine which is tapped for resin.

5. TIDAL FORESTS. The Tidal Forests occur on the sea-coast and along tidal creeks, except on the west coast. The most characteristic trees belong to the mangrove family. The forests that are inundated at high tides by the brackish sea water are important for the valuable Sundri tree. In the delta of the Ganga there are fresh water forests and salt water forests. The fresh water forests occupy the levels which are flooded for some time each day. The flood water is never very salty. During the rainy season, the flood water is almost entirely fresh. This forest is best developed on the ground lying between the drier banks and the 'bils' in the Sunderbans. Tidal forests occur to a small extent also in the deltas of the rivers on the east coast.

Forestry in India

If we leave out the three countries, Russia, U. S. A and Canada which are very largely forested*, India has the largest area under forests. The following diagram compares the forest area of some important countries of the world.

The significance of India's forests, however, does not lie so much in the area, as in the fact that Indian forests

Russia	569
Canada	331
U. S. A.	198

produce some important products which are of great economic importance and which are not produced in other countries of the world. The essential oils and shellac are the produce of Indian forests only.

Roughly one lakh square miles are under forests in India. Burma's separation from India removes more than 1½ lakh sq. miles of forest area from our control. Figure 12 shows the forest share of different provinces.

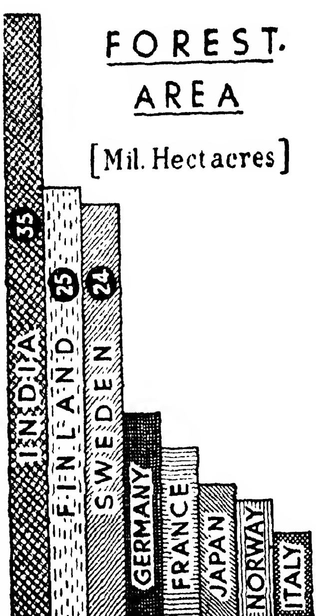

Fig. 11.

This figure is, by no means, large when the vast population of the country is considered. To make the position worse a very large proportion of our forests is inaccessible for effective development and exploitation. For example, the vast forest resources of the Himalayas or of the Sunderbans cannot be tapped for want of good means of communication. It must be remembered that the major product to the forests is timber which is a bulky and heavy commodity, and

*Forest area (Million Hectares)

cannot be economically exploited with outgood transport. In some of the countries of Europe and America easy and cheap method of transport is provided by the winter snow which, hardening into ice, provides a slippery road for the logs. The logs are dragged to the river (which itself is frozen at the time), and floated down it when the snow melts. Nature has not bestowed this advantage on us. The extraction and transport of our forest produce, particularly timber, is often attended with much difficulty in India and may involve engineering problems demanding a high degree of technical skill where the transport of timber is involved.

The methods of transport used in forest exploitation in India vary greatly according to local conditions, but fall naturally under the two main heads of land and water transport. Under land transport the following are common :—

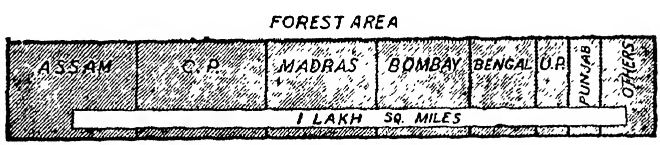

Fig. 12. Provincial Distribution.

(a) Human Transport. This includes the removal by head loads or otherwise fuel, etc., for short distances ; the carriage of sleepers in the Himalayas from the forests down to slides or floating streams ; and the extraction of heavy logs in the same localities with the help of rolling roads and earth slides.

(b) Animal Transport. This includes the carriage of produce by carts where suitable roads exist or by pack animals, such as the employment of elephants to drag heavy timber to floating streams, as in Mysore and the Andamans. Buffaloes are also used for this purpose and are cheaper than the elephants.

(c) Mechanical Transport. This includes tramways, ropeways and skidders. Some of the most important forest tramways in British India are those in Goalpara

division in Assam, and in Changa Manga in the Punjab. Ropeways, worked principally by gravity, are used in various parts of the Himalayas.

Transport by water includes wet slides to points from where sleepers can be floated; telescopic floating in small streams where there is not enough water, and ordinary floating, rafting and conveyance by boats. Water transport is used mostly in the Sunderbans and in Assam.

Causes of Slow Progress

While inaccessibility of our forests and backward transport are, no doubt, causes of the slow progress of forest exploitation in India, it must not be lost sight of that the demand for timber in India is not as great as in some of the industrialised countries of the West. In Europe and in America, whole houses, from the roof down to the floor are built entirely of timber. Our climate will not permit this ; planks are liable to crack in the scorching heat—even the small quantity of timber we use in our houses needs constant care. Besides, the rat and the insects considerably shorten the life of ordinary timber in India. We do not use as much furniture as the people in colder countries do. Our demands of timber are, therefore, less on this account also.

Another difficulty, apart from inaccessibility and lack of demand for timber, in forest exploitation here is that very few types in Indian forests are gregarious, to enable economic exploitation. Most of our timber trees, as for example. Teak, grow mixed with other varieties which have no commercial importance. They do not occur in large stands. This involves a good deal of waste in exploitation and makes it very expensive, in spite of the cheap labour available in India. We have very little pulping wood in our forests. Whatever pulping wood we have, occurs at great heights in the Himalayas where access is difficult. This is unfortunate, for we cannot make use of this wood for making pulp for which there is a great demand. We must import the pulp from foreign countries, therefore.

Inaccessibility of forests, mixed growth of trees, lack of pulping wood, and lack of a large market due to industrial backwardness of the country are the main drawbacks under which forest exploitation in India suffers.

FOREST PRODUCE

Forest produce in India is classed under two heads :—MAJOR PRODUCE, i.e., timber ; and MINOR PRODUCE, i.e., miscellaneous by-products or secondary products like grass, nuts, fibre or resin, etc.

There are a large number of trees growing in Indian forests which produce good timber. The varieties that are commercially exploited, however, are limited. The most important varieties of trees that are at present exploited are the following :—

1. HIMALAYAN SILVER FIRS. They are found in the north-western part and also in the eastern parts of the Himalayas at elevations from 7,500 to 10,000 ft. These trees are tall evergreen conifers, with soft white, not very durable, wood suitable for planking, packing cases, wood pulp and matches. They are at present worked to a small extent, though the quantity available is very large. They are more or less inaccessible at present.

2. DEODAR. This is one of the most important timbers of India. It is a very large evergreen coniferous tree ; a height of 90 to 120 ft. being usual. It grows in the Himalayas at elevations of 5,500 ft. to 8,000 ft. from Garhwal westwards through Jaunsar, the Punjab Hills, and Kashmir, between the outer wet ranges and the inner dry zones. The deodar forests avoid the outer ranges and regions of high monsoon rainfall. They extend to an appreciably lower height on cool aspect. But on sunny ridges, they attain a greater height. The forest is nearly typically pure deodar, only a little spruce, and blue pine being found. The workable area of deodar forest in the north-western Himalayas is about 2,000 sq. miles, but, as in the case of the Silver fir forests, the greater part of the deodar zone lies mainly in the Punjab. The deodar wood is yellowish brown, moderately hard,

oily, strongly scented and very durable. It is used largely by the Indian railways for various purposes.

3. BLUE PINE is another important conifer in India. It grows along the whole length of the Himalayas from Chumbi Valley in Tibet eastward. It grows at elevations of 6,000 to 12,000 ft. Pure strands of blue pine are commoner at the upper and lower limits than in the central part where mixed conifers predominate. Its wood is pink, moderately hard and of good quality. Its workable area is not large, though it is gradually coming into prominence. Most of the workings are in the Punjab.

4. CHIR. The chir is another large size conifer growing to a height of 60 to 100 ft. It occurs in the Himalayas from Bhutan westwards at elevations of 3,000 to 6,000 feet. The chir forest overlaps the tropical deciduous forest at the lower elevations ; while it gives way to the temperate forest above. It is extensively developed in Kashmir, Punjab, U. P. and Nepal. The absence of the chir forest on the southern face of the outer range of the Himalayas is noteworthy, and is due to the combination of excessive heat with heavy monsoon rainfall. The chir wood is light reddish brown, and moderately hard. It is used largely for making tea boxes. The workable area of the chir pine is about 3,000 sq. miles, fairly equally divided between the Punjab and the U. P. The chir is now extensively tapped in the U. P. and the Punjab for the manufacture of resin and turpentine.

5. SAL. The Sal tree is another important timber tree which has come into prominence, due to its large use railway sleepers. The Sal forests occur largely in the vicinity of the Ganga Valley which has the largest network of railways in India. It is, therefore, an added advantage for the exploitation of the Sal forests, as the railways can pay higher prices than building and other trades for the Sal sleepers. The Sal is a large gregarious tree found in Northern and Central India, in the Sub-Himalayan tract from Kangra to the Darrang and Nowgong districts of Assam and in the Garo Hills. It grows also in Chhota Nagpur, Orissa and the Madhya Pradesh. Sal

wood is brown, hard and very durable, though somewhat coarse and cross-grained which seasons slowly. The working area of the Sal forests in U. P. alone is about 3,000 sq. miles, of which only a third is valuable, the rest being covered with inferior trees. The Sal forests of U. P. which alone are exploited to any extent, are divided into three classes :—the hill forests, the bhabar forests, and the terai and the plain forests. Of these, the finest are the bhabar forests. Outside the U. P., good quality Sal is found in Chhota Nagpur only.

6. TEAK. The teak forests provided the most important timber in India when the Burmese forests were considered as Indian forests. Now, of course, its importance has gone, because the teak forests found in the present boundaries of India are not so fine as the Burmese teak forests. Teak forests occur mostly on the Western Ghats, Nilgiris and in Madhya Bharat and Madhya Pradesh. Teak occurs either alone or mixed with other species. Pure forests of teak are generally found on the lower slopes of the hills, or on alluvial flat along the banks of rivers ; or at the bottom of ravines. On the higher slopes of hills, teak occurs mixed with other trees in the forest. The most important areas producing teak are in the districts of Hoshangabad and Chanda in the Madhya Pradesh, and Kanara and Khandesh in the Bombay Presidency. Teak forests are no found north of the Narbada river, no east of the Mahanadi. There is a small export of teak wood from the Western Ghat area. Because of the high price that teak timber fetches, it has been planted in India more extensively than any other single species. The existing teak plantations in India are now estimated to cover an area of about 300 sq. miles.

7. BABUL AND SHISHAM which occur scattered over large areas in the drier parts of the country provide good timber for local use.

MINOR PRODUCE

The importance of Indian forests lies in the exploitation of minor produce, some items of which are in demand

all over the world. The importance of our minor forest produce is not so much in the present stage of development as in its future possibilities. Bamboos, some of the grasses, oils, and tanning materials produced in our forests are capable of providing inexhaustible supplies of industrial raw materials. Unlike timber, new supplies of these raw materials are quickly brought into existence.

The Indian forests are so rich in minor produce of all kinds that it is possible to refer only to those which are or are likely to be of commercial value. Among the more important ones are comprised bamboos, grass, leaves for fodder and for BIRIS, fibres and flosses, oilseeds, tans and dyes, oils, gums, resins, rubber, drugs, and spices, etc. Most of these minor products are produced abundantly in the forests of Peninsular India. Himalayan forests are important mostly for their timber and resins. Bamboos

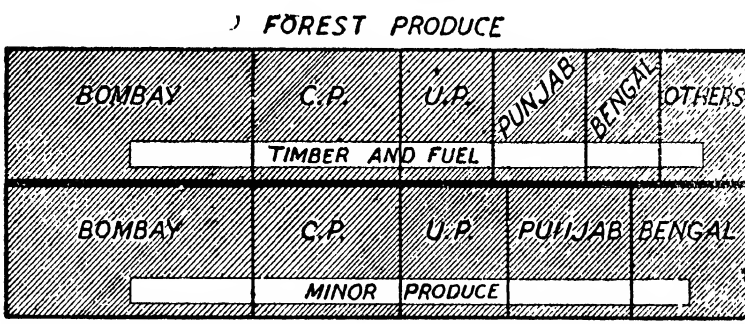

Fig. 13. Provincial Distribution.

grow extensively in all the forests except in the driest parts, the wetter the country the more luxurious is the bamboo growth. Among oilseeds, the mahua seed is the most important. By far the largest proportion of mahua is found in the Madhya Pradash and Bombay. Among the gums, may be mentioned the lac which is produced mostly in the Chhota Nagpur region. Among oils, the Sandal oil is the most important. It is produced mostly in Mysore. Among the tanning materials are the myrobalams (HARRA) and the bark of several species of trees, especially the ba- tree. The importance of these tanning materials will

increase considerably if extracts could be made from them, as is done with the quebracho tree in South America.

During 1935-36 the total produce of timber and fuel amounted to a little over 37 crore cubic feet, or just about I cubic foot per head of population of the country. The minor produce during the same period fetched a little more than 1 crore rupees, or hardly two pice per head of population. The following figure shows the share of the different provinces in this produce.

The main importance of the forest in India is, however, as a source of grazing and fuelwood that it provides. India is a country where there are no grasslands to provide grazing to animals. Forests are, therefore, a great help for keeping animals. India does not use coal as a domestic fuel much. Wood fuel is, therefore, a great necessity. Forest is fundamental in Indian economy; more than in any European country.

Administrative Classification

With a view to better exploitation and protection against destruction, the Indian forests have been classed under (i) Reserved (ii) Protected, and (iii) Unclassed forests. The Government of India is paying attention to the systematic development of Indian forests, and apart from the usual administrative machinery for protecting and working the forests, there is a Forest Research Institute at Dehra Dun to tackle scientific problems dealing with Indian forests.

Realising the usefulness of forests in checking soil erosion, the Government has planted new forests in some of the ravine lands of the Chambal and the Jumna.

Forest exploitation in India received a good impetus from the government during the two world wars. The Utilisation Branch of the Forest Department of India has turned out many good things helpful in forest exploitation. They have discovered new uses for some articles of forest extraction which were going to waste formerly. They have discovered the high Phenolic constituent of the cocoanut shell-tar which might help to supply synthetic resin in

India. They have discovered the suitable timbers for various purposes. Production of shuttles, bobbins, picker arms and battery separations are being manufactured now from Indian timbers as a result of the work of the Utilisation Branch. There are to-day 33 wood seasoning installations in India for producing timber of required quality for certain purposes. Before the War, in 1939, there were only 8 such installations.

It must, however, be remembered that the work of the Utilisation Branch is essentially of an industrial character. Unless, therefore, industrialisation of India is encouraged, any very great result in forest exploitation in India cannot be expected.

QUESTIONS

1. What are the characteristics of Indian forests? How far are geographical factors responsible for them?

2. What factors lead to the growth of grass at the expense of forests in India?

3. What are the causes of the disappearance of the closed forests from the plains in India?

4. What are the main forest types in India? Where do they occur?

5. What is the main forest produce in India? What are the main areas of production?

6. What is the importance of minor produce in Indian forests? Where is the produce mostly found?

7. What are the drawbacks in the way of forest exploitation in India?

8. What is the importance of Sal and Deodar forests in India?

CHAPTER IV

SOILS

The dependence of the bulk of our population on agriculture and, therefore, on soils makes the study of Indian soils of great interest. Unfortunately, very little systematic work has been done in the study of Indian soils. The data available, therefore, is very meagre.

The effect of the rock as well as of the climate on soils in general is clear. Wadia* and others have made an outline study of the influence of geology on Indian soils.

The Imperial Council of Agricultural Research is tackling the study on the basis of climate. The Council has come to a tentative conclusion that according to the influence of rainfall the soil zones of India run north-south. It cannot, however, account, on the basis of climate, for the fact that certain soils assimilate the fertilizers much more quickly than others.

The Imperial Agricultural Research Institute, Delhi, divides the soils of India into the following main classes :—

(1) Alluvial, (2) coarse alluvial, (3) red soils lying on metamorphic rocks, (4) laterite soils, (5) black soils, (6) deep black soils, (7) light soils on trap rocks and (8) deep black alluvial soils.

The alluvial soils of Northern India are further subdivided into (i) Indus alluvial, (ii) Ganges alluvial and (iii) Brahmaputra alluvial soils.

The soils of India offer a distinct contrast to those of many other countries, inasmuch as they are very old, fully matured, and do not in many cases show pedogenic processes and the close relationship between the soil and its rocky substratum. The weathered materials in most cases have been transported to great distances by various agencies. The majority of the soils in India are of

*Wadia : "Soils of India" Records of the Geological Survey of India; February, 1935.

ancient alluvial origin. An examination of them shows that although the nature and composition reflect to some extent the composition of the original rocks from which they are derived, they are the result to a considerable extent, of the climate, particularly the amount and seasonal distribution of rainfall. The monsoon rainfall and the high temperatures that prevail in India, considerably affect the character and sub-aerial denudation of the surface rocks.

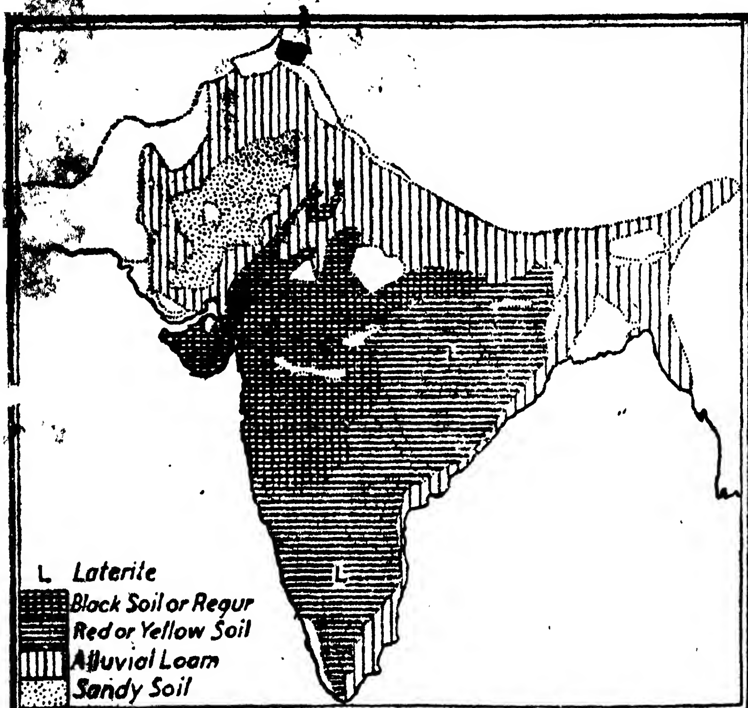

Fig 14.

Compared to the soils of temperate zones the soil temperatures in India are 10°C. to 20°C. higher, and therefore, all chemical reactions involved in the formation of soils proceed many times more intensively. The high temperatures and humidity function so intensively that chemical decomposition follows almost at the heels of rock

disintegration. This feature is particularly conspicuous in the soil formation in the plains in India.

Soils may also be divided into two groups: (i) acid and (ii) alkaline on the basis of their chemical reaction. Alkaline soils are characterised by the presence of appreciable quantities of calcium (lime) and sodium compounds. Acid soils, on the other hand, contain various amounts of hydrogen which replaces calcium and sodium.

Under climatic conditions where precipitation exceeds evaporation, the percolation of water downward through the soil layers causes considerable leaching. In this process the soil bases, particularly lime, are removed from the surface and their place taken by hydrogen, thus forming acid soils. In such cases the farmers add lime to the soil to remove its acidity. This practice of 'liming' is not very common in India.

On Geological basis, the Indian soils fall into two broad divisions;, the soils of the Sutlej-Ganga Plain and the soils of the Peninsular India.

Soils of the Sutlej-Ganga Plain

The soils of the Sutlej-Ganga plain are mostly alluvial. They are classified as sand, clay or loam, which have been derived from the debris brought down from the Himalayas or from the silt left, as in the case of Rajasthan by the old sea which has now retreated. These soils are the deepest, finest and, therefore, the most fertile in India. They consist mostly of loam which is a mixture of clay and sand. The proportion of clay in the loam increases in the newer alluvium, e.g., nearer the deltas of the most important rivers. The character of the soils of the Sutlej-Ganga Plain depends upon the part of the valley where they occur. The soils are the coarsest in the upper section, medium in the middle section and finest in the lowest section of the valley. Sand, being the coarsest, naturally predominates in the upper courses of the rivers, while clay, being the finest particles of the soil, marks the lower courses. Locally sand or clay may occur in any part of the valleys provided there be an elevation where sand may

be deposited, or a depression where clay may be deposited by the flood waters.

In the upper courses of the rivers SAND predominates, being continually renewed by the floods from the Himalayas. Pebbles and large stones are also found mixed with it, specially in the river fans known sa Bhabars. The soil in this section is, therefore, not fertile. In the middle courses of the rivers, deepest alluvium occurs in which clay predominates in depressions. The soil here is the most fertile. In the lower courses of the rivers, finer alluvium in which clay predominates is the rule. The depth of alluvium in this part is not much, but the fertility is great due to the frequent renewals of soils. The fertility of these alluvial soils of the north is due more to the mixing up of the debris derived from new rocks of the Himalayas rather than to the prevalence of nitrogenous matter or humus. The alluvial soils are composed of material drawn from different rocks and, therefore, contain a great variety of salts. This varied nature of salts in these soils is the basis of their great fertility. The alluvial soils respond quickly to the use of manures. They are also easily tilled and are, therefore, the best agricultural soils of India.

Predominantly sandy ridges locally known as 'BHUR,' or alkaline stretches known as REH or KALAR are a feature of these soils. In clayey areas nodules of concentrated lime known as 'KANKAR' also appear near the surface. Such KANKAR deposits are specially marked in Bihar and the eastern parts of U. P.

Besides the alluvial soils, there are some areas in the Punjab where windborne soils (LOESS) have covered the alluvial soils. These loess soils are very fine-grained and highly porous.

The alluvial soils of the Sutlej-Ganga Plain as of other parts of India also, lack in the nitrogenous matter. For example, the soils of the Punjab have been found to contain only from 0·025 p. c. to 0·100 p. c. * of nitrogenous

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*See Pugh and Dutt : Crop Production in India, p. 75.

matter as compared to about 20 p. c. in the best steppe soils of Russia. The Indian soils, however, recoup their losses of the nitrogenous matter much more quickly than the Russian soils can do. They are capable of fixing nitrogen very rapidly.

The alluvial soils of the Sutlej-Ganga Plain are rich in potash, phosphoric acid, lime and organic matter.

Soils of Peninsular India

Most of the soils of the Peninsula are 'diluvial' as opposed to 'alluvial' soils of the north. The diluvial soils remain in the area where they are formed and thus there is no mixing of different rock materials. The fertility of the diluvial soils depends on the chemical constituents of the rocks from which they are derived. The soils of the Peninsula have been classified under :—

1. 'Regur' or the Black Cotton soil of India.
2. Red or yellow soils.
3. Laterite soils.
4. Alluvial soil of the deltas.

The Regur or the Black Cotton soil has been derived from the old lava deposits and is among the most fertile soils of India. It is also known as the 'Trap Soil', as the lava deposits trapped or covered the original rocks. It is so rich in plant food that it has been cultivated for thousands of years without the use of manure. Its main area extends from Bombay in the west to Amarkantak in the east and from Guna in the north to Belgaum in the south. In this area the black soil attains its greatest depth which is about twenty feet in its deepest parts. The greatest fertility of the soil occurs in such parts. Near the margins and on the slopes the soil is thin and the rocks buried under it generally appear on the surface. Apart from this main area the Black Cotton soil is found also in scattered areas all over the Peninsula, e. g., in Bundelkhand, in Tinnevelly district of Madras, and near the Aravalli hills. The Regur of India is similar to the black

soils of Arizona in the United States of America which, too, have been derived from the lava. It is, however, different from the black soils of Ukraine in Russia or the Prairies in North America whose black colour is due to the presence of large quantities of vegetable matter in them. These latter are, therefore, friable and easy to till, while the Indian soil is sticky and very difficult to work, particularly when it is wet.

In some parts of the Peninsula, as in Gujarat and Madras, the origin of the black cotton soils is ascribed to old lagoons in which the rivers deposited the materials brought down from the interior of the peninsula covered with lavas.

Krebs* holds that the Regur is essentially a mature soil which has been produced by relief and climate, rather than by a particular type of rock. According to him this soil occurs where the annual rainfall is between 20″ to 32″, and the number of rainy days are from 30 to 50. The occurrence of this soil in the Western Deccan where the rainfall is about 40 inches and the number of rainy days more than 50, is considered by him to be an exception.

The black cotton soils of India are rich in iron, lime and alumina. They are poor, however, in phosphorus and organic matter. The amounts of potash in them is variable, but it is not much. Thus it will be seen that these black soils are poor in those chemicals in which the other soils of India are rich.

The colour of these soils has been ascribed by some scientists to an organic compound of iron and aluminium. The greatest agricultural drawback of these soils in India is that they crack into deep fissures when dry. They also cake and harden, making ploughing difficult.

The fertility of the black soils is due to their retentivity of moisture, fineness and chemical matters; specially lime.

The red or yellow soils are characteristic of rocks in which large quantities of iron are present. Under

*Krebs : Climate and Soil Formation in South India in the Zeit. Erdkunde, Berlin, 1936.

uniformly high temperatures the iron disintegrates and is spread uniformly in the soil, giving it a red or yellow colour. These soils are, therefore, common in the Tropics. Their main stretch in India is south of the Tapti, though they occur in scattered areas even to the north of the Tapti and in Assam. They are found associated generally with the Eastern Ghats. These soils are highly porous and are fertile only where they are deep and finely grained. They are generally poor in nitrogen, phosphorus and humus. They are poor also in lime.

The Laterite soils are highly infertile and are marked by barren areas where there is no vegetation. They are red in colour and coarse. Stony gravel marks their outer surface. Though red, the laterite soils are to be distinguished from the other red soils. They are composed of a little clay and much gravel of red sandstone rocks. The laterite soils are, as a rule, very poor in phosphoric acid which is the most important plant food. Laterite soils are formed under high rainfall which removes silica from them leaving behind hydrates of alumina in them. Laterite is especially well developed on the summits of the plateaux and the hills of the Deccan, Madhya Bharat, Madhya Pradesh, Rajmahal, the Eastern Ghats region of Orissa, South Bombay and Malabar, and parts of Assam.

The alluvial soils of the deltas are generally silt derived from the flood water of the rivers. Most of the rivers of the Deccan take their rise in the Black Soil area from which they carry large quantities away to the delta. The general characteristics of these soils are similar to those of the Sutlej-Ganga Plain.

SOIL FERTILITY IN INDIA

Indian soils are classed among the fertile soils of the world. This does not mean that the yield of crops from them is necessarily very high: it only means that they are suitable for crop production. High yields of crop always go with intensive farming, implying efficient

manuring at suitable intervals. No soil, however fertile it may be, can show large yields without the addition of suitable manures.

Maeriker classified soils into various classes on the basis of fertility as follows :—

Content of plant food in every 10,000 lbs. of the surface soil—

Class of soil	Nitrogen	Phosphoric Acid	Potash
Poor Soil	5 lbs.	5 lbs.	5 lbs.
Normal Soil	15—25,,	10—15,,	10—15,,
Good Soil	24—40,,	15—25,,	15—25,,
Rich Soil	over 40	over 25	over 25

On the above basis, the Indian soils are rich in phosphoric acid and potash, but poor in nitrogen. The system of agriculture in India has been adapted with this deficiency in view. The pulses, like ARHAR and URAD, and the oilseeds, like groundnut are used in our agriculture largely to supply nitrogen to the soil. These crops manufacture nitrogen from the air at their roots through certain bacteria and thus enrich it to some extent. The poverty of the Indian cultivator does not enable him to use chemical fertilizers to supply nitrogen to the soil. Lack of fuel wood in sufficient quantities in the villages also diverts from the soil to the kitchen fire the very valuable animal manure. Thus, in spite of the fundamental importance of soils to India very little is being done to maintain their productivity.

SOIL EROSION

Nothing is more serious among the agricultural problems of India than the lack or realisation of the loss that the country is suffering through soil erosion. Thousands of tons of good soil are being washed away every year to the sea without the slightest attempt being made to check it in some measure. This loss is greater in India than in most other countries, because of the nature of the Indian rainfall. The huge rainfall of the country which ultimately causes great floods in the big as well as the

small rivers of India carries away large quantities of soil from one part to the other, and finally to the sea. The extensive areas of the ravine lands in the neighbourhood of rivers are a sufficient proof of this loss. The pity of it is that we ourselves lend a helping hand to the running water to carry away our soil. By destroying the vegetation cover of the soil, either through over-grazing or through cutting-down of the forest, we leave the soil unprotected against excessive erosion. In the United States of America and in Russia they have taken the problem in hand already. In India, however, nothing appreciable has yet been done.

The problem of soil erosion is a complicated problem. For soil erosion varies from place to place according to the character of the soil, according to the slope of the ground, according to the vegetation cover, according to the use to which the soil is being put, and according to the nature and the amount of rainfall. The solution of the problem lies, therefore, not in any one fixed methods but in adopting several methods that will take into consideration all the above factors. The main object is to retard the speed of run-off. Planting of trees, regulating grazing, building of dams across the ravine lands, and contour-terracing* are some of the methods that have been followed in foreign countries to check soil erosion.

QUESTIONS

1. In what respects do the soils of the Peninsular India differ from those of the Indo-Gangetic Basin?

2. What are the characteristics of the Regur Soils of India? How do they affect the agriculture of the region?

3. Give an account of the soils of the Indo-Gangetic Valley.

4. What is Soil Erosion? Suggest some methods for checking it in India.

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*Contour terracing means making a level terrace on elevated ground running in the direction of the contour and not across it. Thus, the water in the terrace flows only slowly and does not cause excessive erosion.

CHAPTER V

AGRICULTURE

Agriculture is the most important industry of the people in India. Leaving out China, there is no country in the world in which so many people depend on agriculture for their livelihood as in India. About 80 per cent of our total population is engaged in this industry.* Yet, in spite of it, the present-day agriculture in India cannot be said to be scientific agriculture. Commercialization is just beginning, and until it is fully accomplished, specialization, leading to scientific agriculture, is not possible. Owing to the backward state of agriculture, therefore, the Indian peasant is among the poorest in the world.

Agriculture in India is characterised by certain features which are not met with in the agriculture of the industrialised countries of the West. There the requirements of factory workers dominate agricultural production. The features of Indian agriculture are :—

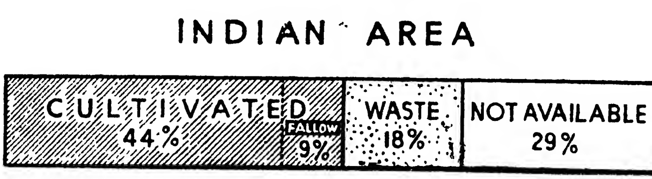

Fig. 15

(1) Most of the land in India is devoted to the cultivation of food grains. Fig. 16 shows that about four-fifths of the cultivated area here is under food crops. (2) There is no crop which is grown for the specific purpose of providing fodder for cattle or other animals. Cattle

*The total Area sown in India in 1949-50 was 337m. acres.
The total Area sown in U. S. A. in 1949-... was 369m. acres.
Cereal Production in India in 1949-50 was 44m. Tons.
Cereal Production in U. S. A. 1949-... was 37m. Tons.

fodder in India is largely a by-product of the food crops. (3) The use of manures is very scanty and haphazard. Most of the animal refuse which gives the best all-round manure, is burnt as fuel, owing to the scarcity of forests in the important agricultural areas here. (4) The yield per acre, therefore, is very small. (5) The Indian bullocks on whom falls the whole of the agricultural work are weak and puny creatures who cannot pull big ploughs necessary for deep ploughing. (6) Besides, very deep ploughing is not suited to Indian conditions, as the heavy downpours of rain tend to wash away a large part of the finer soils turned up by the heavier plough. (7) As contrasted with the cold or the temperate land agriculture, Indian fields generally produce more than one crop in the year. (8) Severe losses occur in Indian agriculture owing to droughts, as the irrigation facilities are inadequate.

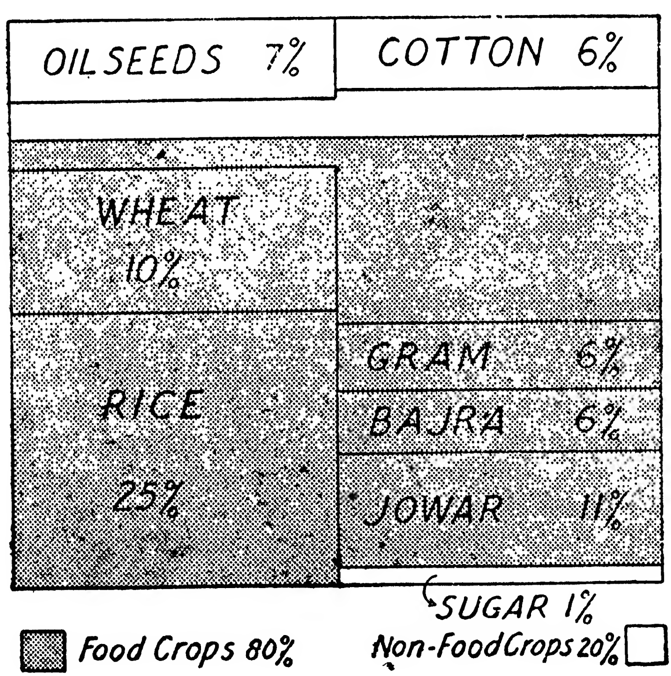

Fig. 16.

Of the total area of India, roughly 53 per cent is cultivable About 9 per cent of the total area, however, is left fallow every year and only about 44 per cent is, therefore, the total net area sown annually. A little less than one-half of the total sown area in India lies in the Sutlej-Ganga Plain.

More than two-thirds of the area sown in India is occupied by the three crops, rice, millets (Jowar, Bajra, Gram and Ragi) and wheat. Among other important crops are the oil-seeds and cotton.

RICE

India is the second largest producer of rice in the world, the first being China. The following table gives the production of Paddy in some countries in 1949-50 in lakh metric tons :—

China	445
India	330
Pakistan	123
Japan	115
Indonesia	100
Thailand	56
Indo-China	51
Burma	42

Rice is by far the most important crop in India,* from the point of acreage and the number of people it supports. Rice is a special crop of the monsoon lands where alone it finds almost ideal conditions for its growth. Sufficiently high temperatures, high rainfall, and FERTILE ALLUVIAL PLAINS, this combination is seldom met with in any other climatic region of the world. Besides this happy combination, the monsoon lands are densely populated areas with abundant supply of cheap labour. For it must be realised that rice cultivation is not suited to mechanical

*The following table gives the area and yield of the important crops in India in 1949-50:—

cultivation. It needs plenty of hand labour. But water is the limiting factor in the cultivation of rice in India. Mountain slopes have been terraced or marshes drained to make rice farms wherever water is enough for the needs of rice. Where rain-water is not enough for rice, but where rice must be cultivated for some reason or the other, irrigation has to be provided.

Rice in Bengal

Bengal is the largest producer of rice in India. Most of this rice is obtained from the AMAN crop which is sown in June and harvested about November. It will be seen from the following table that during this period copious rain falls regularly in Bengal :—

RAINFALL AND TEMPERATURE IN BENGAL

Months	April	May	June	July	August	September
Rain (Inches)— ...	3·3	7·6	14 5	14·9	14	10·7
Temperature (F⁰)	83·5	84	84	83	83	83

Bengal provides another requirement of rice cultivation in its uniformly high temperatures. But a high temperature is not so essential as high rainfall. For rice is cultivated on the slopes of the Himalayas even on

	Lakh acres	Lakhs	
Rice	738	227	Tons
Wheat	241	63	Tons
Oilseeds	250	51	Tons
Cotton	118	31	Bale
Sugarcane	36	49	Tons Gur and Sugar
Jute	11	31	Bales

heights of 8,000 feet or so above sea-level where temperatures are not high.

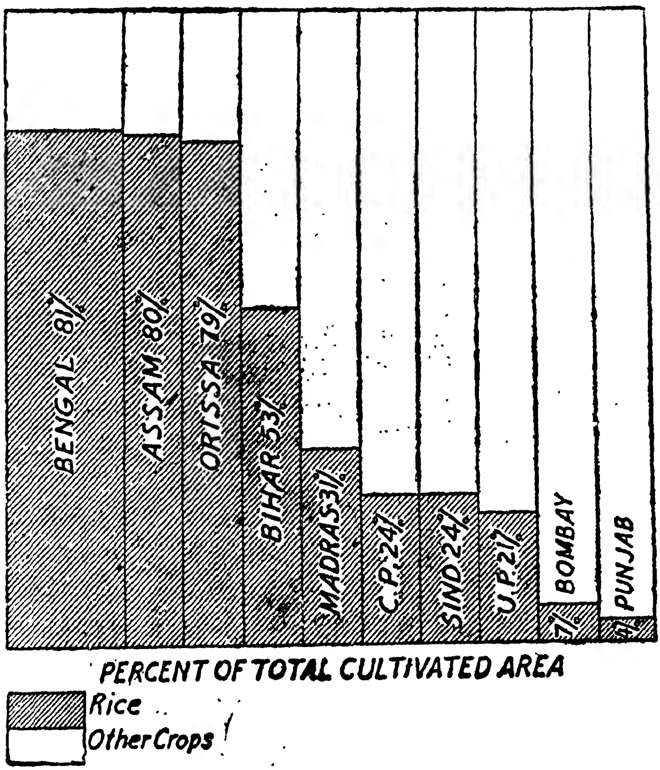

Fig. 17. Rice in Provincial Agriculture.

Except China, about which reliable statistics are wanting, India produces and perhaps consumes also the largest amount of rice in the world. Most of the Indian supplies come from Madras, Bihar, and Bengal. During 1949-50 these three states produced about 50% of the total Indian crops. The following table shows provincial share in rice production :—

RICE IN 1949–50.

	Lakh acres	Per cent of Total		Lakh Tons	Per cent of Total	
Madras ...	103	14%	82%	38	17%	79%
Bihar ...	138	19%		37	16%	
Bengal ...	79	13%		36	16%	
Orissa ...	94	13%		20	9%	
Madhya Pradesh	88	12%		25	11%	
U. P. ...	83	11%		23	10%	

The importance of rice in Bengal's agriculture is shown by Fig. 18.

A comparison of the rainfall map given on page 10 with Rice map given on page 81 shows the dependence of rice cultivation in India on rainfall. As one proceeds further into the interior of the country where rainfall decreases, there is a fall in the cultivation of rice. This is shown in Fig. 17 above in the declining importance of rice cultivation in the total cultivated area of the provinces. A large proportion of the rice grown outside Bengal and Assam is irrigated. This is specially so where either the rainfall is precarious or scanty. Rice crop cannot bear long intervals of drought. Except in U. P. and the Punjab, there are two to three crops of rice every year ; autumn, winter and spring crops.

Rice is considered generally as a winter crop in India, as over the whole of the country it is harvested mainly from November to January. The sowing lasts from April to August for most of the varieties grown in India. But in the main rice-producing areas of Bengal, Assam, Bihar, Orissa, and Madras there are, autumn and summer crops of rice as well. The rice season in Madras varies greatly. The first crop is sown between May and December and gathered from September to April. The second crop is sown between October and March and harvested between January and June.

The three main crops of Bengal and the neighbouring areas are given in the following table :—

RICE CROPS OF BENGAL

Crop	When sown	When transplanted	When harvested
1. Aus ...	April-May ...	Sown Broadcast	August-September
2. Aman...	June ...	July-August ...	November-January
3. Boro ...	October ...	December ...	March.

When rice is cultivated on high lands or on dry lands which are not completely submerged during the rains, it is sown broadcast in the field itself. But when it is cultivated in lowlands which are filled with water during the rainy season, it is first sown in nurseries from where the plants are transplanted into the fields when they are about a foot high.

In those lowlands where the water is too deep for transplantation of rice plants, a special crop of rice is sown broadcast in February or March before the rainy season starts. This crop is harvested only after the water has subsided in the field after rains.

(1) AUS or autumn rice crop. This is sown in April or May on comparatively high land and harvested in August or September. Aus paddy cannot be grown on land on which more than two feet of water accumulates during the rainy season. The land on which this paddy is grown is generally light and easily workable.

(2) AMAN or winter rice crop is sown from May to June and harvested from November to January. It faces complete submergence and the uprooting action of rushing water. It increases in height along with the rise in water level.

Aman rice is the most important in Bengal. More than three-fourths of the rice acreage and output is

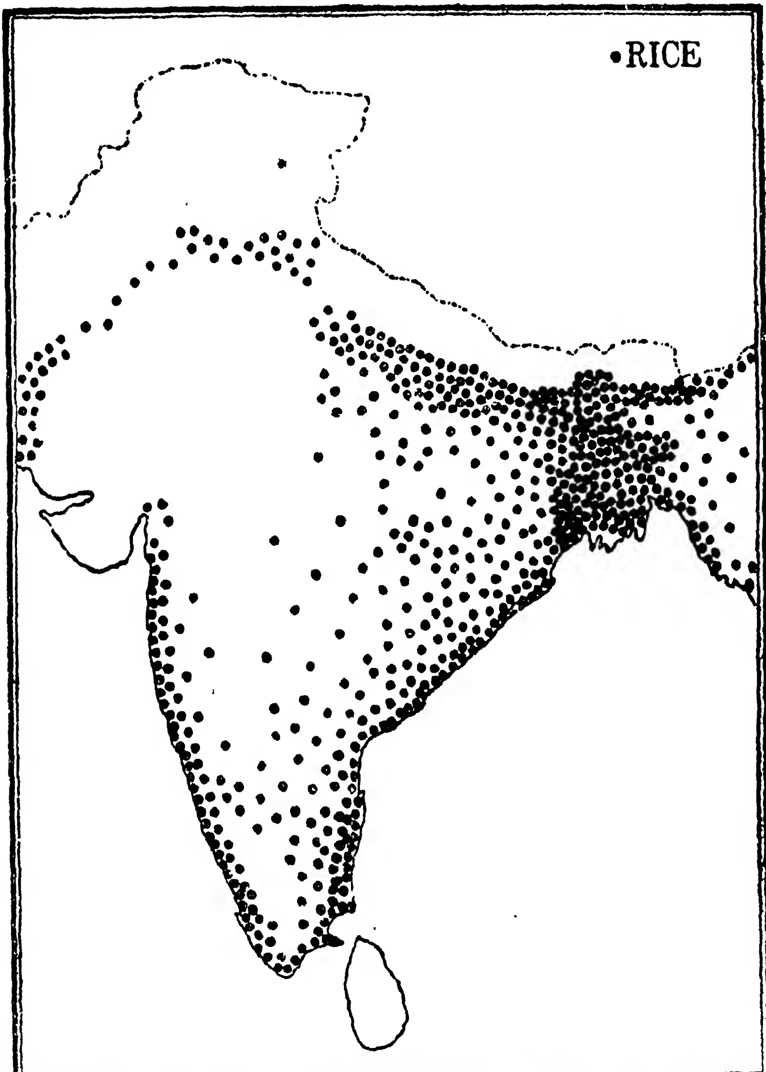

Fig. 18.

accounted for by it. The following table shows the share of each crop :—

AVERAGE 1928-42

Crop	Acreage %	Output%
Aman ...	75	78
Aus ...	23·5	20
Boro ...	1·5	2

(3) BORO or spring rice crop. It is sown in depressions and swamps from October onwards when the rain water has subsided and is reaped in March. It grows in dry season and has to face droughts during the later period of its growth when the water in the depressions is drying up. The yield per acre of this rice is the highest*.

The rice crop in Bengal, and in other provinces where irrigation is not much practised, is damaged to some extent by the vagaries of rainfall. The rice crop of Bengal is also sometimes damaged by untimely floods in the Ganges due to late and heavy rainfall in U. P. These floods fill the depressions along the river with water which cannot be used for sowing the winter rice crop, as the water does not dry up in time for sowing,

Rice cultivation in Bengal is done almost without any manuring of the fields. It is only recently that green manuring is being advocated. Fortunately, however, large parts of Bengal are subjected to river floods resulting in considerable deposits of silt which help the land to regain fertility. To save the cultivator from loss, the Agricultural Department has developed by research

*The average for 1938-42 in Maunds per acre in Bengal :—

Aus Rice	10·9
Aman Rice	12·4
Boro Rice	13·6

early maturing varieties, as also high yielding varieties. Among the improved varieties, may be mentioned the 'Dhairal' of Bengal which yields upto 32 mds. per acre (2,560 lbs.).

Other Areas

The distribution map of Rice (Fig. 18) shows that there are two areas in India which grow practically no rice. These are the Black Cotton Soil area and the desert and semi-desert of Thar and Rajputana. These areas do not have enough water for rice cultivation.

In the Punjab rice is grown in the canal-irrigated areas during summer only.

Rice is also important all along the Himalayas in the Terai region, as well as in the mountain river valleys. Kashmir is an important producer. In these parts there are two crops of rice raised, owing to early maturing varieties.

In U. P. the eastern districts and the submontane districts are the chief producers of rice. Rice is, however, also cultivated to some extent in the canal-irrigated areas. There is only one crop of rice raised here. The crop is, however, precarious in eastern districts, whenever the rains fall short or are irregular. There are not enough facilities for irrigation of rice in these districts. Rice requires plenty of water for irrigation which cannot be easily raised from the wells common in these districts of U. P.

Increasing Supply

In spite of the large acreage under rice in India the yield per acre is very low. The average yield per acre in India is only 703 lbs. as compared with Japan's 2,350 lbs. The highest yield of rice in India is in Bengal. This is due to the absence of manuring in India. The table on a subsequent page shows that India does not produce rice enough for her own requirements. She is short by about 24 lakh tons. This deficit will increase as the population increases, unless greater outturn of

rice is possible. We have already seen that water sets a limit to further extension of rice cultivation in India. The only method, therefore, to increase the output is to increase the yield. The yield at present can be raised only by greater application of manure. The Government of India proposes in its new Five-year plan to increase the rice acreage by 92 lakh acres and rice production by 24 lakh tons in 1955-56.

In 1939 the total area under rice in Japan was about 8 million acres, producing about 12 million tons. This gives an average of about 1½ ton per acre. But in India the total acreage under rice in 1938-39 was 73 million, and the total production about 24 million tons. This gives an average of about ⅓ ton per acre only. We must note here that Japan has the largest catch of fish in the world. This enables a large amount of fish to be diverted to manuring of the rice fields in Japan, the value of fish as manure being unrivalled.

Trade in Rice

The trade in foodgrains is not free now. Movement of rice is on government account now. Indian Government has to import rice from any country with which it can bargain. In 1948-49 about 9 lakh tons were imported, Burma, Siam, and Brazil supplying about 8 lakh tons.

The large population of the rice-growing parts of India does not leave any surplus of the crop for export purposes. Most of the trade in rice is inland trade. The largest inland movement of rice is from Madhya Pradesh, a thinly populated area. The largest inward movement is into Cochin, Madras, Bombay and Bengal, where the rice-consuming population is considerable, but where the local produce is not enough.

Rice husking mills first clean the paddy and remove the husk before the rice is brought to the market. In the rice-growing areas there are many rice mills, the largest number being in Bengal. In some of these mills, the husk is used as fuel, in others oil-burning machinery is common.

The rice straw is tough when dry, owing to the hot and moist conditions under which rice grows. It cannot, therefore, be used as fodder. It is used for burning, for thatching of roofs or for making mats. With industrial development of the country it can be used for various purposes like cardboard making and plastics, etc. These uses can bring to the cultivator plenty of money. This is an argument in favour of industrial development of India on a large scale.

WHEAT

Wheat is the most important commercial grain in India. It is important in areas in which rice is not important, because the climatic and soil requirements of the two grains are different. Wheat requires a fertile loam or any other fertile soil, provided it is not too wet. It GROWS best in a cool, moist climate and RIPENS best in a warm, dry climate. The largest acreage under wheat is found, therefore, in the drier and higher parts of the Sutlej-Ganga plains. During 1939-40 out of the 34 million acres under wheat in the whole of India more than 20 million acres or about 60 p. c. were in the Indo-Gangetic Valley west of Banaras, and only 1 million acres, mostly in Bihar, in the lower Gangetic Valley east of Banaras. There is no factor so injurious to wheat as the excessive humidity which marks the eastern section of the Gangetic Valley, both because of higher rainfall and its impervious soil. Madhya Pradesh, Madhya Bharat, Rajputana and Bombay Presidency are the chief producers of wheat in the Peninsula. All these parts are in the interior of the Peninsula, away from the wet coastal regions.

Thus, it may be said generally that wheat cultivation in India increases from the south to the north ; that is to say, on leaving the humid atmosphere and the inundated soils of the south and the east. Wheat is practically absent from the red and yellow soils. The other area without wheat cultivation is the Thar desert. The following table shows the distribution of wheat in India :—

Wheat in 1949-50

	Lakh acres.	% Of Total.		Lakh Tons.	% Of Total.	
Uttar Pradesh ...	82	34%	78%	25	39%	82%
Punjab ...	29	12%		12	20%	
Madhya Pradesh ...	25	10%		5	8%	
Madhya Bharat ...	20	8%		3	5%	
Bombay ...	20	8%		3	5%	
Bihar ...	16	6%		3	5%	

Wheat in Punjab

Before partition the Punjab, with its fertile, alluvial loam, its moderate rainfall and its cool winters easily occupied the largest share. On the basis of the ten-year average (1930-31 to 1939-40) 10 million acres or 29 p. c. of the total acreage under wheat in India was in the Punjab. Most of the wheat area in the Punjab was found in the northern Punjab. Thus, the five districts, Lyallpur, Multan, Attock, Ferozepur and Montgomery accounted for about one-third of the total wheat area of this province. It is in the northern Punjab that abundant irrigation facilities are found. This naturally accounted for the importance of wheat there. Not only in area, but in wheat output also the Punjab ranked first in India. About 3 million tons, or 30 p. c. of the total output come from the Punjab. While in area and in total output the Punjab stood first in wheat cultivation, its yield per acre was comparatively low. If the average yield per acre is compared, the Punjab stood sixth in the provinces important for wheat in India. Even the best yield in the Punjab was lower than the best yield in some other provinces. The highest recorded in the Punjab was 1250 lbs. per acre in Jullundhur, which may be compared with 1374 lbs. in Nawabshah in Sind, and 1300 lbs. in Bulandshahr in U. P. After partition, the Punjab (i) became second only to U. P. in wheat production.

Wheat in U. P.

U. P. stands first in wheat. It has about 8 million acres, or 34 p. c. of the total wheat area in India. The total output from U. P. is about 2½ millions tons, or more than 39% of the Indian output. In fact, U. P. and the Punjab account for more than about one-half of the area and about two-thirds of the output of wheat in India. Most of the wheat area in this province lies in the doab between the Ganga and the Gogra rivers. More than one-half of the wheat area is in this region. Next in importance comes the doab between the Ganga and the Jumna. The least important districts for wheat in U. P. are those lying at the junction between the Peninsular regions and the Ganga Plain. The wheat cultivation is also important in the districts east of the Gogra, owing to the fertile soil and the irrigation facilities from wells. In fact the largest acreage under wheat in U. P. is in the district of Gorakhpur. This is, however, due to the fact that this district has the largest cultivated area in U. P. The proportion of the area under wheat to the total cultivated area in this district is only about one-seventh. This may be compared with the one-third in Meerut and one-fourth in Bulandshahr.

The average yield per acre is the highest in U. P. (about 1000 lbs. per acre) when compared with the provincial yields. Higher yields in U. P. are characteristic only of the irrigated areas in the Ganga-Jumna Doab and in the districts east of the Gogra. It is the unirrigated areas that lower the average yield in U. P.

Other areas

A study of the geographical distribution of wheat in India reveals that it is grown mostly in the alluvial soils of the Sutlej-Ganga basin and the Black Cotton Soil of the Peninsula, provided the rainfall is less than 40 inches.

The relative importance of wheat is not the same for all provinces in India. In some it is more important than in others. In Bihar it is only 5 p. c. of the total

net area cultivated. In Madhya Bharat it is 44 p. c. In the two most important wheat provinces of the Punjab and U. P. the percentage is 20 and 22 respectively. It must be realised that wheat is a 'money crop' and has, therefore, to compete against other money crops like sugarcane and cotton. The best land is, therefore, divided among the money crops. This division, however, depends upon rainfall fluctuations. When rainfall conditions are unfavourable the poorer crops like barley or gram occupy the land that is usually allotted to wheat.

Peculiarities of Wheat in India

A special feature of the wheat crop of India is that, unlike that of the cool temperate countries of the world where alone the largest supplies of wheat come from, in India it is a winter crop. For it is only then that suitable temperatures are available here. Wheat is sown in India from October to December and is harvested from March to June in different parts. As winter is a dry period over the area where wheat is grown here irrigation plays the most important part in its cultivation in India. In some years when the monsoon rainfall has been in defect, even sowing of wheat is done with the help of irrigation. In Europe and in America, wheat is grown in summer when enough rain falls. Irrigation is, therefore, not an important feature of wheat cultivation in those regions. It is only in Australia, South Africa, and the western part of the United States of America, which are practically deserts, that irrigation is resorted to for this crop. After about a fortnight from the end of the monsoon rains in northern India and when the nights have become sufficiently cool to cause the formation of dew in the fields, i.e., about the end of October, wheat is sown in the fields which have been prepared beforehand. Wheat is sown only in the loamy soil of the older alluvium. The field in which wheat is intended to be sown usually remains fallow during summer when a little manure is also given. Unlike most of the summer crops, which are sown broadcast, wheat is carefully sown in the drills made by the plough.

This is a clear proof of the esteem in which the Indian cultivator holds it for its commercial importance. The winter rains and the facilities of irrigation in the areas in

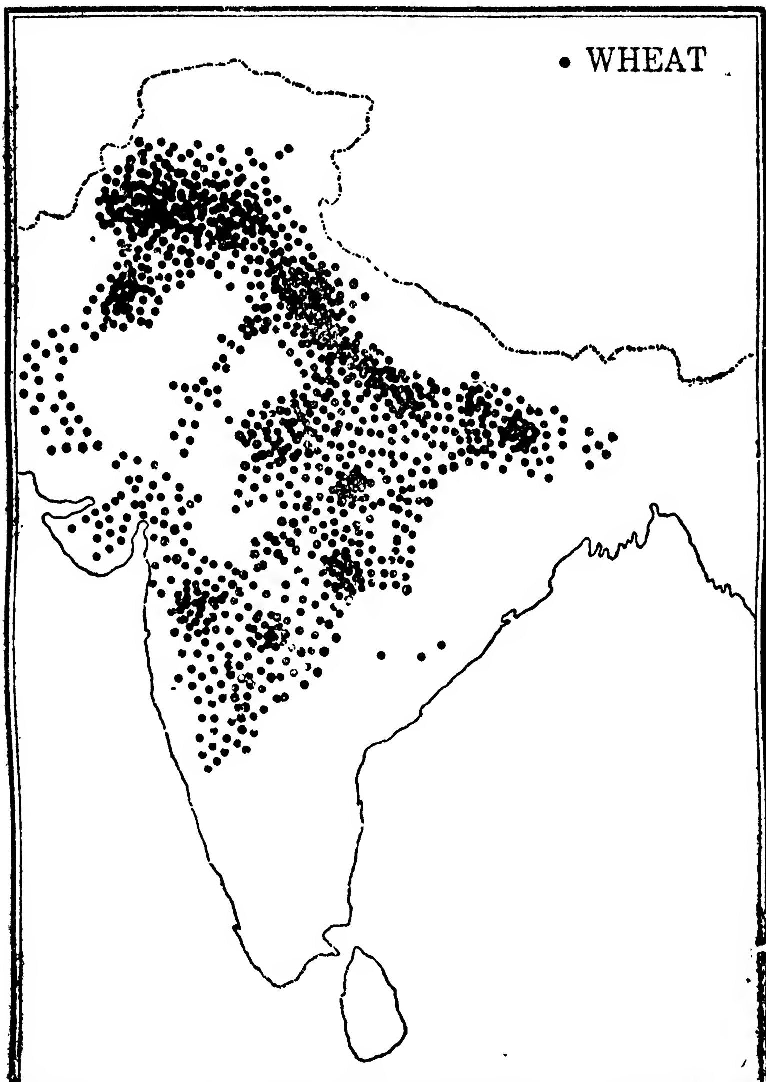

Fig. 19.

which wheat is important are an advantage to wheat in India, as they provide moisture to the plant during its early growth which, accompanied by the cool temperature of December,helps tillering, and a number of stalks shoot from the same seed. By the end of February when the grain has formed, temperatures begin to rise and help in the ripening of the crop.

There are certain climatic drawbacks under which Indian wheat is cultivated. These drawbacks arise particularly about the time of harvest. The change from winter to summer is almost sudden in India. The rise of temperature is not gradual, as in Russia or Canada or the other wheat-producing countries, and, therefore, the crop

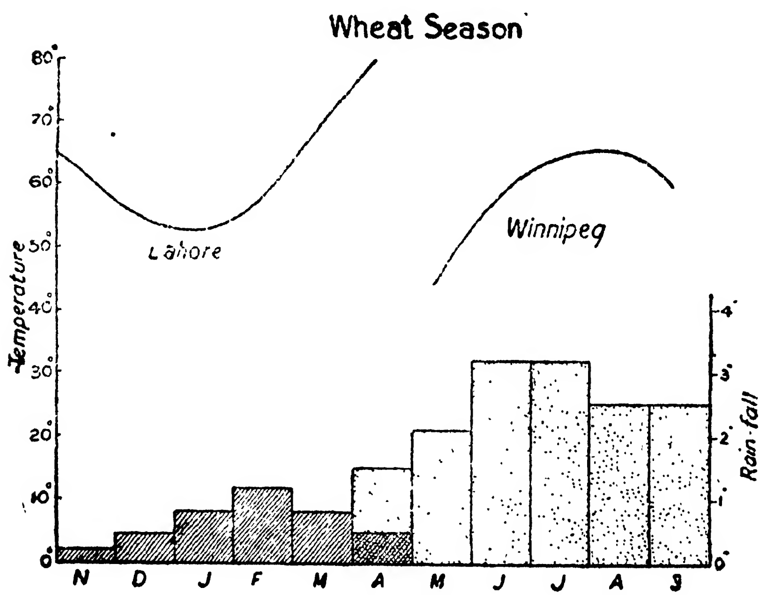

Fig. 20. Climatic conditions under which wheat is grown in the Punjab and in Canada.

matures not gradually but quickly. This sudden ripening of the crop leads to the inferiority of the wheat grain in India. The rise of temperature is usually accompanied by the setting in of very dry winds which quickly dry up the sap in the grain, which is thus, not a fully developed well-

rounded grain as in other countries, but a shrivelled up and thin grain. This wind often blows with considerable speed and tends to spoil the crop by felling the plant to the ground, as the indigenous Indian plant has a weak straw. Local storms leading to hail and rain are also common in northern India during March and April and cause difficulties in the gathering in of the crop.

In India most crops are harvested by gathering in the whole plant and not only the grain as in America, because in India the straw has considerable importance for fodder. Among villages in India, while there is trade in grain there is PRACTICALLY NO trade in fodder which has, therefore, to be carefully conserved. This method of crop gathering in India causes considerable amount of impurities in Indian wheat for which it is even now disreputed in the world market.

Fig. 20 shows the climatic conditions under which wheat is grown in the Punjab and in Canada. Note from the shape of the curves the sudden and the gradual rise of temperature in the two areas. In India the crop ripens in suddenly increasing temperature, while in Canada it ripens in gradually falling temperature. The amount of rainfall during the wheat season in India clearly indicates the necessity of irrigation. In Canada, on the other hand, the rainfall is enough for the crop.

It will be noticed that in India while the GROWING PERIOD of wheat is characterised by FAVOURABLE climatic conditions, the HARVESTING PERIOD is marked by UNFAVOURABLE conditions.

The yield per acre of wheat in India is very low, owing to the poverty of the Indian cultivator who cannot afford much manuring. Even though farming here is 'intensive' Indian yield ranks with the lower yields of the newer countries of America or Australia where the farming methods are 'extensive' and cannot, therefore produce high yields per acre. The yields per acre in the 'intensive' farming countries of western Europe are about three times as much as in India. The largest yield per acre in India is in the western districts of U. P. and the

lowest in Chhota Nagpur. It is to be noted that the yield per acre is low in all the important producers of wheat in the world. Russia, U. S. A., Canada, India and Argentina, all record low yields.

Increased Supplies

Shortage of wheat supplies in recent times in India has drawn attention to the possibilities of increasing supplies of wheat in the country. It will be noticed that geographical considerations limit the cultivation of wheat to certain areas of India only. But wheat is a commercial crop in India that is grown essentially for its money value. It has, therefore, to compete with other commercial crops, like cotton or sugarcane. During the last few years, owing to the great rise in the prices of these latter crops, a certain amount of land suitable for wheat cultivation has been diverted to their cultivation. The wheat supplies of India have, therefore, not kept pace with the increasing population of the country. This has naturally resulted in a shortage. Under normal conditions, however, the working of the laws of Economics would adjust the shortage by making it worth-while for the farmers in India to devote more land to wheat. But India needs not only more wheat, but also more cotton and more sugar now. The only method of increasing wheat supplies, therefore, lies :

(i) in extending irrigation facilities to bring more land under wheat cultivation ;

(ii) in introducing scientific agriculture by improving seed, manuring, cultivation, etc.

Figure 36 ahead shows that only about one-third of wheat crop in India is irrigated. The other two-thirds of it has still to do without it. If irrigation could be provided for this portion of the crop, increase in supply is bound to occur.

Similarly, the use of manures, better seed and other improvements in wheat cultivation are likely to increase the yield of wheat per acre and, therefore, the total supplies. The Government of India's new plan proposes

to add 56 lakh acres to wheat acreage and 18 lakh tons to wheat production by 1955-56.

Trade in Wheat

India normally stands fourth among the world producers of wheat. The largest producers of wheat in the world are Russia, U. S. A., Canada and India. Indian produce is about one-third of that of Russia and about one-half of that of U. S. A. The commercial significance of the Indian crop formerly lay in the fact that it reached the European market when the crops of other countries were still growing in the field. The importance of this fact has, however, considerably dwindled now, because of the large wheat stocks in the world market in normal times. The demand for Indian wheat in Europe was mostly for mixing with other varieties of wheat to produce a big loaf. Most of the exports went to Great Britain, Belgium, Germany and Italy. Within recent years, owing to the shortage of food in India all exports of wheat from India have ceased. On the other hand, India has to depend on imports of wheat from outside. Only recently India has contracted with the U. S. A. for the import of 20 million tons of wheat. In 1948-49 India imported about 17 lakh tons of wheat from U. S. A., Australia and Argentina.

The largest inland movement of wheat and flour is from the provinces where it is produced most, viz., the Punjab, U. P. and Madhya Pradesh. The largest inward movement is into Calcutta, where a large wheat-consuming population has gathered from the north. Bombay and Rajputana, where the wheat produced is less than the local demand, are other areas of large demand. The movement is, however, now on government account only and is all over the country according to requirement.

Barley and Gram

Barley and gram are two other winter grain crops which rank along with wheat as staple foodgrains of northern India. Together they occupy about the same

acreage as wheat in India. The largest production of these grains is in those parts of the Sutlej Ganga Plain where wheat cannot be grown as a winter crop. Thus, dry, sandy or moist clayey areas, as well as those areas where irrigation facilities are lacking are devoted to these grains. Barley and gram mixed together provide the poor man's food in those parts of northern India where rice is not abundant. About two-thirds of barley and about one-half of gram supply of the whole of India comes from Uttar Pradesh. The yield per acre of these grains, particularly of barley, is higher than that of wheat. They also do not require so much care and attention as wheat, but they are cheaper and do not fetch as much money as wheat. It is, therefore, only under compulsion from nature that the Indian cultivator grows them. His first preference in northern India is always wheat. There is very little trade in these grains. A small amount of barley is used for brewing beer ; while some amount of gram is used as horse or animal feed.

Millets

Millets include a number of inferior grains in which Jowar, Bajra and Ragi predominate. These grains cover a larger acreage than any other grain in India, except rice. Millets are grown in all those areas where the soil is rather infertile owing to its rocky or sandy character. The largest acreage under them occurs in the Peninsular India, with Bombay and Madras Presidencies leading. The least acreage is in Bengal.

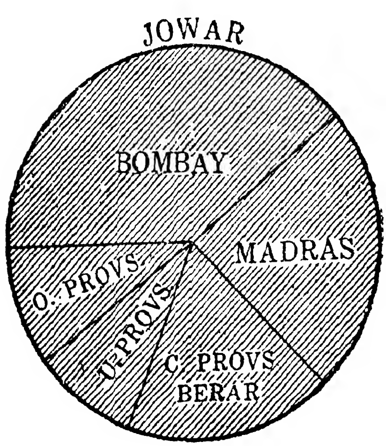

Fig. 21. Provincial Distribution.

Jowar prefers wetter and more clayey soil, while Bajra grows well in drier and

sandier soil. The millets are the chief summer grain crop in all the areas where rice is not grown. Their importance lies not only in the fact that they are a staple food

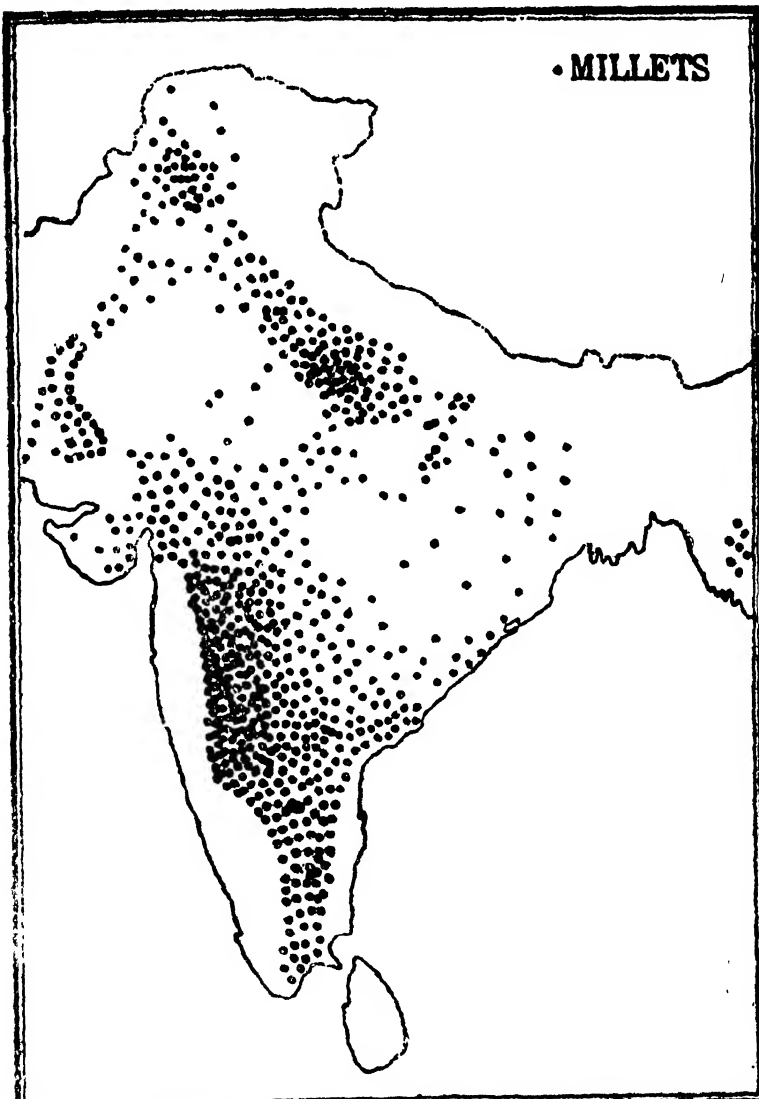

Fig. 42.

for a very large section of the people of the Peninsula throughout the year and in northern India during winter, but also in the fact that they provide a substantial part of the fodder supply of India. The fodder value of the Jowar plant is so great that in some parts of the U. P. and the Punjab the crop is raised even by irrigation solely for that purpose. Dr. Voelker in his Report on Agriculture in India speaks very highly of the nutritive value of Jowar as a fodder. There is practically no trade in millets.

Bombay Presidency is the most important producer of JOWAR. JOWAR is more important in this area as a RABI crop than as a KHARIF crop. Bombay is the only province in India where JOWAR is grown as a RABI crop, as well as a KHARIF crop. JOWAR is a staple crop where black and mixed black soils predominate, provided the rainfall is moderate and well distributed. Where the rainfall is excessive it gives place to rice. On sandy loams and shallow soils its place is taken by BAJRA. In U. P. and the Punjab, JOWAR is also grown as a fodder crop. It is then known as 'CHARI' and is given irrigation when necessary.

MAIZE

Maize also, like the millets, is considered as an inferior grain in India. It prefers fertile soil, specially loam and is, therefore, grown mostly in U. P. and the Punjab. More than four-fifths of the crop is found in the Sutlej-Ganga Plain. It is grown with the first summer rains and is reaped almost as soon as the rains stop. Its cultivation is adversely affected if the rains come late, and the crop is damaged, if there are very long intervals between the rainy periods. The cultivation of maize as well as the millets in India is characterised by 'interculture'; that is, several things are sown mixed. Among the seeds sown thus, are several vegetables, like pumpkins and cucumbers, various kinds of pulses like 'urd' 'mung,' and 'arhar' and some oilseeds like sesame. All these, except the 'arhar' are collected before the main crop. Arhar, on the other hand, takes full winter to mature and is harvested separately with the rabi crops.

This 'inter-culture' has an important and scientific place in the agricultural practice of India. Some of the crops like the 'arhar' have deep tap roots on which form the bacteria which enrich the soil. Inter-culture has thus its agricultural value. The vegetable crops mature quickly and provide food to the poor agriculturist at a time when his stock of food is at the lowest. Inter-culture has thus its economic value.

There is only local trade in maize. Its stalks, too, are tough when dry and have no value for fodder. They are generally burnt or used for thatching.

Climate in India does not favour the cultivation of maize to any large extent. Very high temperatures during the growing period are the main obstacle. It will be seen that the region of the greatest production of maize in the United States of America, which produces the bulk of the world's supply of maize, has a mean summer temperature of 70° to 80° F. In India, on the other hand, we notice that the average is more than 85° F. during the period maize is grown here. This unfavourable climate is mainly responsible for the low yield per acre in India in comparison with the United States.

SUGARCANE

The cultivation of sugarcane has made enormous progress in India within very recent years as a result of the growth of Indian canesugar industry under State protection. Thus, the history of sugar beet in Europe has been repeated in India in the progress of sugarcane. The growth of cane cultivation in India is shown by the rise in area under cane from 2° million acres in 1929-30 to more than 4 million acres in 1936-37. The greatest expansion has been in Bihar and U. P. where the best conditions for cane cultivation are found.

At one time India had the largest acreage under sugarcane in the whole world. Indian acreage was about

three times that of Cuba and about seven times that of Java, the two islands which have dominated the world production of sugarcane in the past. India was also the largest producer of canesugar in the whole world, producing about four times that of Java, Hawaii or Brazil, about three times that of Philippines and about one and a third times that of Cuba. Even now India is the second largest producer against Cuba's 57 lakh tons in 1947* This great production in India was due not to high yields but to the immense area under sugarcane. The production of sugar in India, however, surpasses all countries including the countries producing beet sugar. The average Indian production for the period 1931-32 to 1936-37 was 73 million quintals as compared with 38 millon quintals in Germany, which was the greatest producer of beet sugar in the world.

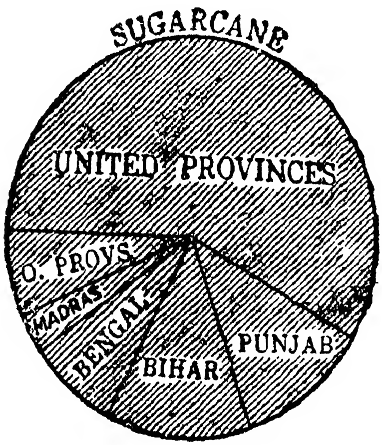

Fig. 23. Provincial Distribution.

Even though sugarcane is grown all over India in favourable localities to some extent or the other, because of its great money yield, its greatest concentration occurs in the submontane districts of the Middle Ganga Valley, where U. P. has 54 per cent of the total Indian crop. The Sutlej-Ganga provinces, U. P. (54%) the Punjab (15%) and Bihar (12%) together account for four-fifths of the sugarcane area of India. The following table gives the area and production :—

*In 1949 Cuba produced only 48 Lakh tons of sugarcane. The world production was 19 million tons.

Cane Acreage and Production, 1949-50.

	Lakh Acres	% Share	Lakh Tons	% Share
U. P. ...	21	58% } 77%	26½	54% } 66%
Bihar ...	4	11%	3	6%
Punjab ...	3	8%	3	6%
Madras ...	2		5	10%
Bombay ...	1½		4	8%
Total India	36		49	

This concentration is due to :

(i) the fertile alluvium which is renewed every year by the numerous mountain streams flowing into the area ;

(ii) the high water level enabling easy irrigation ;

(iii) the flat plains providing ease of cultivation ;

(iv) absence of frost ;

(v) high rainfall ;

(vi) high temperatures ; and

(vii) facilities of irrigation from the many wells, (which cost very little to build) and canals.

There are, however, small areas of cane cultivation spread locally all over the country. They have not been shown in the map, because the areas are too small. The existence of such areas clearly proves the importance of sugarcane as a money crop to the Indian cultivator.

The yield per acre of sugarcane is higher in the Peninsular region than in the north. The following table shows some of the yields per acre in 1948-49 :—

Bihar	9·8 Tons
U. P.	11·7 „
Mysore	18·2 „
Hyderabad	20·9 „
Bombay	32·9 „

The Indian cane is of a thin variety and is not so thick as the cane in Java or other tropical islands where

the continued supply of moisture and hot temperatures produce plenty of juice in the cane. In India, the long break in the rains does not favour the growth of thick,

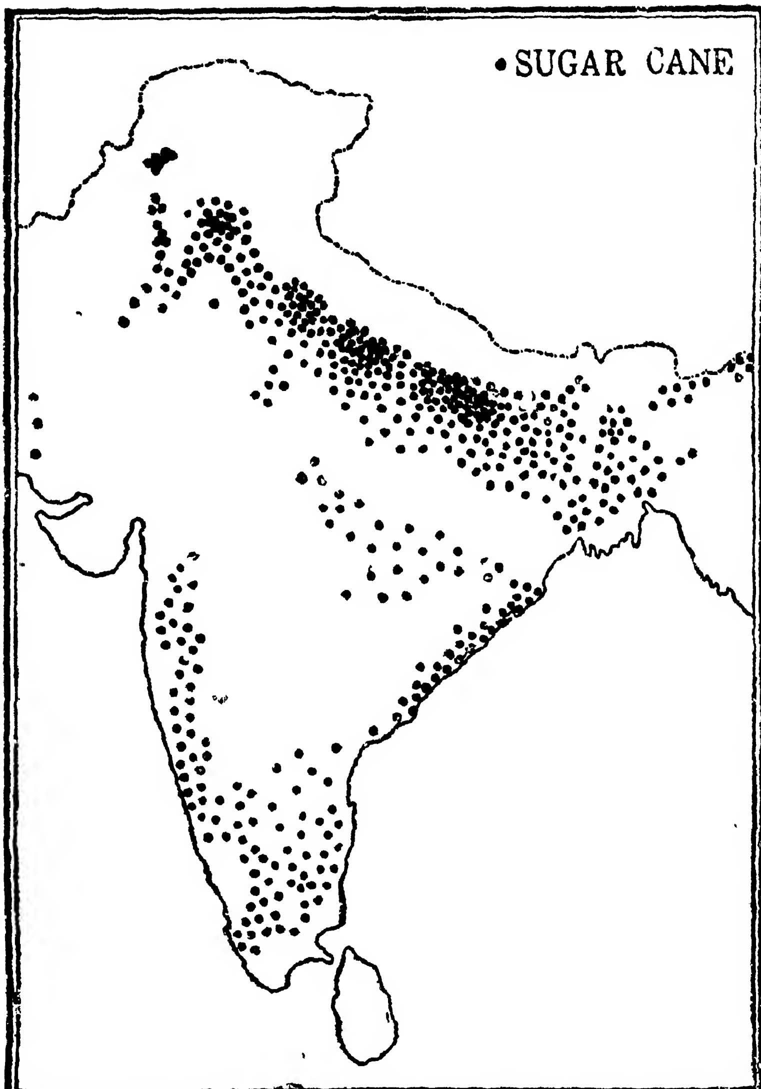

Fig. 24.

juicy canes under average conditions. The cane which has practically supplanted the old indigenous varieties in India is the Coimbatore cane, bearing different numbers according to the seedlings obtained by crossing with different varieties as well as with other plants like JOWAR.

Coimbatore has been selected as the centre for researches in sugarcane, because its climate is ideally suited for cane. One important effect of the introduction of the Coimbatore canes has been that 'ratooning' has become popular in India. Ratoon crop is the second or any successive crop of cane obtained from the roots of the cane left over in the field from the first crop. Ratooning avoids the need of fresh sowings of cane every year. In India ratooning is generally uneconomical after two years, as the crop becomes infested with cane diseases like 'red rot'. The sucrose content of the Punjab canes is, however, lower than that of the canes of U. P. or Bihar. This is believed to be due to the soil differences. The amount of exchangeable calcium in the Punjab soil is lower.*

Other areas where sugarcane is important in India are Bengal, Madras and Bombay.

Most of the cane produced in India is used locally for crushing in the sugar mills erected all over the sugarcane area in the country. One of the main factors in the rapid increase of sugar cultivation in India has been the demand for cane from these mills. The land lying near these mills, wherever practicable, has all been converted into cane-land, the cane replacing all other crops. An important example of this replacement is noticed in the Terai region of the Himalayas where the land, formerly given to rice is now devoted to cane. The shortage of foodgrains in the country in recent years, has, however, checked this tendency. The following table shows this :—

*Agriculture and Animal Husbandry in India, 1934-35, p. 84, Government of India Publication.

Acreage under Sugarcane in India

Year	Lakh
1944-45	51
1945-46	38
1946-47	41
1948-49	37
1949-50	36

OILSEEDS

The importance of oilseeds in India is more for their oil being used for food than for industrial purposes. There is a large variety of oilseeds grown all over India both as a summer and a winter crop, but the greatest importance attaches to Groundnuts, Cotton seed, Rape seed and Mustard. The yield of the first two of these is generally more than twice the yield of all the others put together. The importance of oilseeds for export trade is considerable also. The oilseeds are divided into two broad classes, edible and non-edible. The latter includes linseed and castor. The following tables give the figures for oilseeds :—

Oilseeds Acreage, 1949-50 (Lakhs)

	Groundnut	Rape and Mustard seed	Linseed	Castor	Sesame	Total
U. P. ...	3	29	9	—	9	50
Madras ...	38	—	—	2	6	46
Bombay ...	19	—	—	1	—	20
Hyderabad ...	16	—	5	8	7	36
Madhya Pradesh...	7	1½	11	—	4	23½
Saurastra ...	7	—	—	—	—	7
Bihar ...	—	3	3	—	—	6
Assam ...	—	3	—	—	—	3
Punjab ...	½	2½	—	—	—	3½
Rajasthan ...	—	2	—	—	5	7
Total ...	97	47	37	14	46	

Oilseed Production, 1949-50 (Thousand Tons)

	Groundnuts	Rape Mustard	Linseed	Castor	Sesame	Total
U. P. ...	102	502	148	2	76	830
Madras ...	1646			22	79	1747
Bombay ...	731	4		12	32	779
Hyderabad ...	406		38	60	47	551
Madhya Pradesh ...	163	32	90	5	28	318
Saurastra ...	212			2		214
Bihar ...		46	48	4	4	102
Assam ...		58				58
Punjab ...		42	—		7	59
	3408	774	413	118	379	

The total area under all the oilseeds in India in 1949-50 was about 24 lakh acres, which was more than the area under wheat in this country. About half of this area is in the Deccan plateau. The largest area under oilseeds is in U. P. (50 lakh acres).

Groundnuts are by far the most important among the oilseeds in India from the point of view of area and production. It is an important money crop for the farmer. About one-third of the total acreage under oilseeds is occupied by this one crop. India is now the largest producer and exporter of groundnuts in the whole world, as well as the largest consumer. More than one-third of the world's total acreage under groundnuts is found in India. There are at present 9 million acres under this crop in India producing about 34 lakh tons of nuts. The importance of this crop in Indian agriculture is only recent. At the beginning of this century there were less than 3 lakh acres under it in India. This importance developed mainly on account of its export value. To-day,

however, the home market is more important than the export market, for India now consumes more than three-fifths of the crop. The growing use of 'Vanaspati' which is manufactured from the groundnut oil is largely responsible for this. The principal areas under this crop are in Madras, Bombay, and the Hyderabad State. Practically the whole crop is grown in the Peninsular India. U. P. is the only important producer outside the Peninsula. The groundnut, apart from yielding the oil which is used for making vegetable ghee, increases the fertility of the soil, because of its bacteria-forming roots. In Mysore Ragi sown after groundnut produced on an experiment farm 88% more than Ragi sown after Ragi.

The cultivation of groundnuts requires a light soil, preferably rich in organic matter. The red and yellow, and the black cotton soils of the Peninsula suit it well. Much rainfall is not required; a rainfall of 20 to 30 inches is quite enough, if it comes during the growing season. In Madras and Bombay part of the crop is raised with irrigation. Groundnuts cannot stand low temperature; they need a temperature of 70° F to 80° F. Dry weather is required at the time of ripening.

COTTON SEED also is mostly produced in the Peninsula. COCOANUT and CASTOR are also almost a monopoly of the Peninsula.

RAPE AND MUSTARD seeds are very widely grown in in Sutlej-Ganga Valley. They are not important in the Deccan, as they prefer a fertile, alluvial soil with comparatively dry winters. Out of the total area of 47 lakh acres under this class about 38 lakh acres are in the northern parts. In the Punjab, the crop is known as TORIA. In U. P. this crop is grown alone only over a small area which is only about 2½ lakh acres. A large amount of this crop is, however, grown in this province mixed with other winter crops. U. P. occupies a much higher place in the cultivation of Rape and Mustard.

SESAMUM (Til or JINJALI) is also very widely grown in India. It is, however, more important in the Deccan

than in the Sutlej-Ganga Valley. Madras, Bombay, Hyderabad and Madhya Pradesh are more important.

LINSEED is another important money crop for the Indian farmer. It has acquired a great importance within recent years in Indian agriculture, owing to its enhanced importance for export trade to Great Britain. It now occupies over 3 million acres (which is as large as the acreage under sugarcane), most of it lying in U. P. is, however, insignificant when compared with Argentina, in South America.

CASTOR is also important only in the Deccan. Hyderabad, Madras, Mysore and Bombay account for practically the whole of the crop. Bihar and U. P. are only nominal producers outside the Peninsula.

The exports of oilseeds have, on the whole, now decreased. Groundnut is an important exception; the marked increase in its export being due to an increase in area. The exports of oilcakes and vegetable oils have also increased, but the increase in the quantities of oilseeds crushed for local consumption is still more striking. From the increased quantities of oil manufactured in India, various minor industries have developed, e. g., Soap-making, hair-oil-making, paint and varnish-making and vegetable ghee-making. Gouripore in Bengal is now famous all over India for the supply of boiled linseed oil for the paint and varnish industry. In 1950 there were 47 Vanaspati manufacturing factories in India with a total productive capacity of about 3 lakh tons per year. The total capital invested in these factories was about 222 crores.

There are about 600 oil mills with an annual crushing capacity of about 27 lakh tons. Ghanis crush about 6 lakh tons yearly. In 1948-49 about one lakh tons of oilseeds, and about 65,000 tons of oil were exported from India.

The export of oilseeds is not profitable to India. It is against the real interests of the country. The main arguments against this export are that by exporting the raw oil-seeds to foreign countries :—

(1) India loses the oilcake which is a valuable manure for the soil and a nutritious cattle fodder.

(2) India has to buy back from these countries at a high price the vegetable oil that it needs for her industrial purposes like the making of paints and varnishes, and soap, etc.

(3) India thus pays the higher wages of the foreign labour employed in oil-crushing industry in foreign countries, while depriving her own people of the work and the wages they could get in crushing mills in India.

(4) The development of our industries like soap-making, etc., is retarded for want of cheap vegetable oils.

Tea

Tea is now the most important money crop in India. The cultivation of tea was started in India by the Government, as an experiment, in 1834. This experiment was undertaken as a result of a minute recorded by Lord William Bentinck, the then Governor-General of India. It was urged in that minute that great "advantages would result to India, in commercial point of view, from the success of the scheme, and that it would also place England in an independent position in respect to China." A committee of thirteen members was appointed to start the scheme. Two of the members of the committee were Indians and the rest Europeans.

The committee obtained a quantity of seed and a few seedlings from China which succeeded well in the soil of Assam. A few tea-makers and artisans were also introduced from China in 1837. Some consignments of the tea thus produced in Assam were then sent to London for sale. These consignments proved of excellent quality and fetched a very high price. The prices commanded by this tea were so good that the experimental tea cultivation in India attracted the attention of British capitalists. A company, later known as the 'Assam Company,' was, therefore, formed for tea cultivation in Upper Assam. The Indian Government transferred to this company most of its tea gardens and nurseries.

The committee appointed by the Government also discovered that the tea plant grew wild over a tract of Assam extending from Sadia to Yunan, the frontier province of China.

The tea plantation in India was, therefore, started with three types of plants; the chinese type, the indigenous type, and the hybrid type (a mixture of the first two).

The china type is very hardy and yields under circumstances that would be fatal to the more delicate indigenous or the hybrid type. But the china type produces a hard leaf which costs more in manufacturing and is of less commercial value than the tea produced from the indigenous or the hybrid types. The hybrid type has, therefore, become popular in India.

India is the largest producer of tea in the world. The crop is, however, highly concentrated in a few hilly districts of India. 76% of the total AREA under tea plantations lies in Assam (in the Brahmaputra and Surma Valleys) and in the two adjoining districts (Darjeeling and Jalpaiguri) of Bengal. The elevated region over the Malabar Coast, in Southern India (including the Travancore, Cochin Malabar, Nilgiris and Coimbatore) contains 19 p. c. of the total. The Punjab, U. P. and Bihar account for the rest. There are about 5,000 tea estates in India comprising about 8 lakh acres. These estates employ about 12½ lakh people in the tea industry.

The ideal climate for the cultivation of tea is the one where the daily variation of temperature is from 75° to 85° F. If the atmosphere is very moist, this variation may be a little greater. A rainfall of about sixty inches annually, if it is well distributed throughout the year, is enough. Nothing is more injurious to tea crop than long dry periods.

The next graph shows that at Jalpaiguri, an important producer of tea in India, the temperature during the producing period from June to September varies between 78° and 89° F. The relative humidity of the air, that is to say, the proportion of moisture in relation to the temperature, during this period is very high; about 90%.

From March to May, the temperatures are very high and the range between the highest and the lowest temperatures—great, as is seen from the distance separating the lines of minimum and maximum temperatures in the

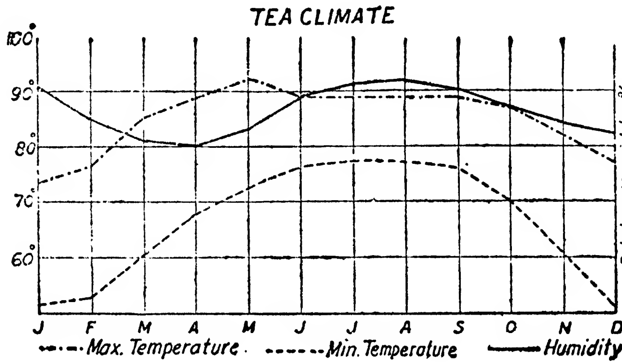

Fig. 25. Meteorological obseivations at Jalpaiguri, Bengal.

graph. During this period, however, the relative humidity is very low, when compared to other months. But even this low relative humidity is never below 80%. This fact is an important climatic factor favouring tea cultivation in this district.

A soft and well-drained soil is the best for this crop. Light, sandy and deep loams are much perferred. Apart from the production of leaves on the tea-bush, the flavour of tea depends largely on the chemical constituents of the soil. Relatively large quantities of phosphorus and potash in the soil account for the special flavours of the tea produced in Darjeeling. The soils in which tea is grown in the Himalayas vary considerably, but the best is a light, rich soil containing a good deal of humus mixed with sand.

The tea plants are raised from seeds and not from cuttings. Tea plants, reserved for seed production, are not used for gathering the leaves, but are allowed to grow to a height of 20 or 30 feet. The seeds are sown in nurseries and the seedlings; when about six months old, are then

planted in fields which have been specially prepared beforehand.

The sowing of seeds starts in October or November and continues upto March. The seedlings are transplanted when the rains begin. During dry periods after transplantation irrigation has to be provided to help the plants to grow up. The plant is ready for plucking in three years. The season for gathering leaves commences about the beginning of April and continues until October. There are generally three gatherings from each plant every season. The first is some time from April to June, the second from July to August and the third from September to October. The number of gatherings, however, depends entirely on the nature of the season. If the season be good ; that is to say, if rain falls in winter and in spring, as many as five gatherings may be obtained.

Pruning of the plant is an essential part of tea cultivation. It is done annually during the period when the plant growth has stopped. In India the period of pruning is generally from December to March. The aim of pruning is to have new shoots bearing soft leaves in plenty. It also keeps the tea bush low enough to facilitate the plucking of leaves from the ground.

In order to help the plant to grow plenty of leaves, considerable attention is paid by the tea-planter to maintain it in good health. Frequent tilling of the soil to eradicate weeds, and the use of several kinds of manures is generally practised. The most common manures in India are the oil cakes. Recently, green manuring has also been practised. In Ceylon, large quantities of chemical manures, like sulphate of potash are used.

In India, tea is grown in three different climates :—

(i) in the cooler climate of the hills—Darjeeling, Kumaon, the Nilgiris and the Kangra Valley ;

(ii) in the warmer climate—Lower Assam.

(iii) Midway between the above two—Upper Assam. The districts where the indigenous tea plant was found growing wild.

The third is about the best climate for tea in India.

There is an intimate connection between the climate and the yield and the quality of tea in these areas. In the hilly areas mentioned under (i) above, the yield is low, but the quality is good ; in the areas under (ii) above, the yield is the heaviest, but the quality is the worst. The area under (iii) above must be regarded, as a whole, midway both in yield and quality between (i) and (ii).

The largest production of tea in India comes from the following areas :—

1. THE BRAHMAPUTRA VALLEY IN ASSAM. The most intensive cultivation of tea here is found on the red alluvium which forms small plateaux in the districts of Tezpur and Bishnath.

2. THE SURMA VALLEY. This valley comprises mainly of Cachar district. There are many TILAS or low hillocks all over the district. These hillocks are surrounded by lowlying flat land, locally known as BHEEL, which was formerly a swamp. These swamps have now been drained, and in many cases black soil highly charged with organic matter has been uncovered. On these soils tea flourishes exceedingly well. In addition to these flat lands, tea has been planted also on plateau land similar to that in the Brahmaputra Valley.

3. THE DUARS. There is a strip about 10 miles broad lying at the foot of the Himalayas, south of Sikkim and Bhutan. The most characteristic feature of this strip is a bank of hard but porous red soil on which tea has been extensively planted.

The greatest yields of manufactured tea per acre plucked are recorded in the Brahmaputra Valley of Assam. The average yields here are more than 700 lbs. per acre. The lowest yield is in Garhwal, about 60 lbs. to the acre.

Most of the tea produced in India is 'Black Tea.' Very small quantities of 'Green Tea' are produced here. In 1938, of the total production of Indian tea, only about 1·5 p. c. consisted of Green tea, the rest being all Black tea. The Kangra Valley was responsible for producing more than two-thirds of the Green tea in India.

The difference in the black and the green teas is, of course, one of method of the preparation of the leaf. The Chinese green tea is coloured artificially by ferrocynide of iron and Prussian blue which gives them their fine bluish colour. No artificial colouring of tea is, however, done in India.

The manufacture of tea or the preparation of the leaf for the market is comparatively a simple process. It involves the drying of the leaf partly in the sun and partly on fire. The proximity of forests to tea plantations is an advantage, because it gives charcoal for fire and wood for packing boxes. In nature, all the tea leaves are green.

Until recently, the Indian tea industry depended for its prosperity almost entirely on the foreign market, especially British. The exports* of Indian tea are the largest in the world and are taken mostly by Great Britain which accounted for 87 p. c. of our exports in 1938-39. In 1950, of the total value of our exports to Great Britain amounting to £98 millions, tea accounted for the largest share, £3+ millions. The exports to Britain are, however, not all meant for that market. A considerable proportion is re-exported from there to the European countries in which Russia is the most important. Russia is, .however, developing her own tea plantations in Georgia which produced in 1939 about 25 million lbs. in comparison to 19 million lbs. only in 1938. This increasing production of tea in Russia is bound to have an adverse effect on our tea exports.

Turkey is also planning to grow tea in the neighbourhood of Rize on the Black Sea. Canada, U. S. A., Iran, Ceylon and Burma took in on year about 10 p. c. of our exports. Among all the producers of tea India has the largest home market. In 1950, India consumed about 160 million lbs.

*Total export ers of tea in 1939-40 were as follows :—

	India	Ceylon	N. E. I.	British East Africa
Exports (Mil. lbs.)	363	227	160	22
Home Consumption (Mil. lbs.)	101	10	30	?

Thus, not only is the tea production in India confined to a small area but its trade is also limited almost to one market—Great Britain.

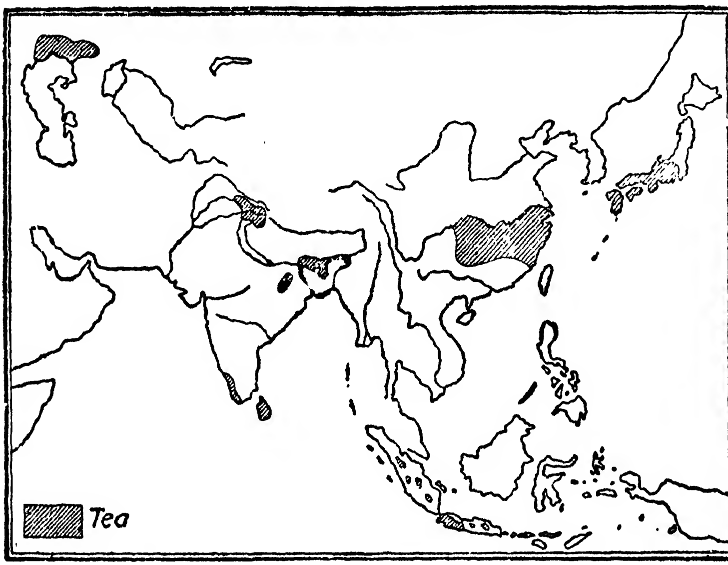

Fig. 26.

Practically all the exports of Indian tea go from the ports of Calcutta and Chittagong, Calcutta accounting for more than one-half of the exports.

The application of restriction to the tea industry since 1933 has resulted in many gardens producing the permissible crop from a smaller acreage than they are at present cultivating. This has resulted in throwing out of commission the poorer producing areas and obtaining the crop from the areas producing the greater crop. The poor areas so thrown out of commission are being replanted with new and better plants so that in a few years' time, when these plants become mature, such areas will have a considerably greater potential producing capacity. This scheme of restriction in India is under the control of the Indian Tea Licensing Committee, which works under the International Tea Restriction Board located in London. The

function of this body is not only to fix export quotas for various countries and tea estates there, but also to create new markets for tea. For this purpose the Indian Tea Market Expansion Board has been brought into existence. It arranges for free supply of tea to expand its market and carries on an advertising campaign in favour of tea drinking. The activities of this Board are financed by a tax levied on all exports of tea from India. Owing to the activity of this Board in India the home consumption of tea has been rising.

As may be expected, the working of the restriction scheme has resulted in bringing in to prominence certain economic considerations; such as the desirability of producing a large crop from a small area so as to reduce costs and also the production of the best quality owing to the limitation of the total crop. An experimental Research station for tea exists at Toklai in Assam.

Recently, growing of shade trees amongst the tea plants has been started, because the tea under shade has a better cropping value than the tea away from shade. Several species of leguminous trees have been planted for this purpose.

In 1949, India produced 595 million lbs. of tea. This was an all-time record. Of this produce about 100 million lbs. was from the south. The accompanying diagram shows the distribution of Tea production in India by Provinces. The position of Assam is outstanding. In Madras, roughly about half of the production comes from Travancore. The Punjab, U. P. and Bihar produce only minor

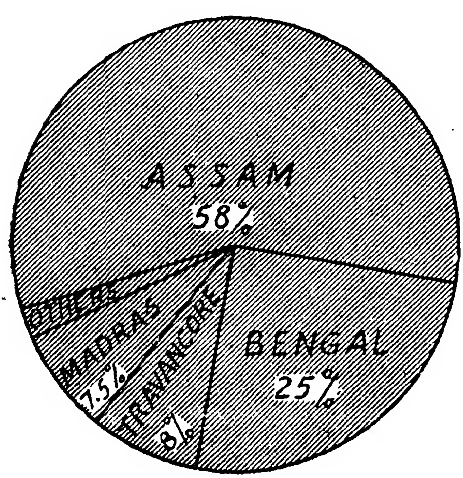

Fig 27. Provincial Distribution.

amounts. This diagram is based on the ten yearly average of 1930-1939.

The Indian production of tea is the largest in the world, forming about 44% in 1937. This was about twice that of Ceylon, three times that of the Dutch East Indies, and about four times that of Japan.

The effect of the two Great Wars has been to stimulate considerably the production of tea in India for British and other markets. Great Britain has, however, entered into an agreement with the Indian tea industry, whereby the prices charged from Britain will not be excessively high.

Coffee

Although the coffee industry in India falls far short of the tea industry in the country, it is interesting to note that in Southern India it covers a larger cultivated area than either tea or rubber. In 1949-50.the total area in India under Coffee was about 2 lakh acres.

Coffee growing was established on a firm footing in Southern India in the last century, between 1830 and 1840, first in Mysore and then in Wynaad, Nilgiri and Shevaro Hills. Later in 1854, the first coffee plantation in Coorg was opened from which a great expansion has taken place.

The coffee industry of India is confined to Southern India, comprising Madras, Coorg, Mysore, Travancore and Cochin. Of the total area under coffee Mysore accounts for more than half, and Madras and Coorg 22 p. c. each. The highest average yield per acre of plucked area is in Cochin and the lowest in Mysore. The principal markets for Indian coffee are the United Kingdom and France. Indian production of coffee is insignificant in comparison with the world production of coffee.

The Indian coffee crop gives, on an average, an yield of about 17,000 tons. The home consumption is estimated to be about 7,000 tons per annum, so that there is an exportable surplus of about 9,000 tons per

year. India produces some of the best coffee in the world, and yet her exports are negligible, specially because of the competition from Costa Rica, British East Africa and Colombia. The consumption of coffee in India is very low. About 96 per cent of the coffee available for home consumption is consumed in Madras, Coorg, Mysore, Travancore and Cochin. The rest of the country consumes only 4 per cent.

Tobacco

Tobacco requires a good soil and heavy manuring. The best kind is a well-drained friable, sandy loam, not too rich in organic matter, but rich in mineral salts like potash, phosphoric acid and iron. Light soils which allow a full development of the roots of tobacco are the best for it. But heavy soils are used in India for growing *Hookah* tobacco. It is most susceptible to frost. It is therefore, grown largely in the frost-free provinces, *viz.*, Bengal, Madras, Bihar and Bombay.

The Indian variety of tobacco (*Nicotiana Rustica*) is a more rapidly growing species than the variety generally grown in the temperate regions of the world (*Nicotiana tabacum*). In the field this tobacco grows most rapidly with a mean temperature of about 80° F. It also requires a liberal, well-distributed rainfall or its equivalent in irrigation water. For the water requirements of the plant are high. Tobacco plant is also very sensitive to defective drainage or waterlogging of the soil. It needs well-drained soil.

In the cultivation of tobacco it is the quality of leaf rather than quantity that is aimed at. High yields are, therefore, incompatible with high quality, because high yields of leaf always imply a rank vegetative growth. For good cigarette tobaccos, therefore, relatively low yields are essential to the production of leaf of the highest quality.

The importance of Indian tobacco is considerable.

In world production India ranks high, contributing about one-fifth of the total.*

TOBACCO IN 1949-50

	Thousand Acres	Thousand Tons
Madras	294	84
Bombay	202	56
Bihar	55	18
W. Bengal	46	12
U. P.	34	11
Orissa	32	11
Hyderabad	31	7
Total India	774	223

Tobacco is grown mostly wherever the soil is a rich sandy loam with water only a few feet below the surface. Shallow wells are dug all over the tobacco fields, and during certain stages of the growth of the crop hand irrigation is done daily. The irrigation is followed not only to supply moisture to the roots but also to wash the dust from the leaves. Wherever the red clay soil appears, tobacco cultivation is not found.

In Madras, tobacco is grown in all districts, though on the Nilgiris and the West Coast the area is small. The seed beds are usually located near shallow pools in which the monsoon rains stand.

The bulk of the Indian production is consumed within the country. There is also a valuable export trade in unmanufactured leaf. The increase in the production of flue-cured and other types of cigarette tobacco in India has led to a decrease in the imports of readymade cigarettes into India. The imports of cigarettes into India in 1929-30 were about 5 million lbs., but in 1934-35

* The production of some countries in 1949-50:—

	Million lbs.
India	500
Turkey	269
Pakistan	175
Iran	25

they gradually dwindled to 0·61 million lbs. The number

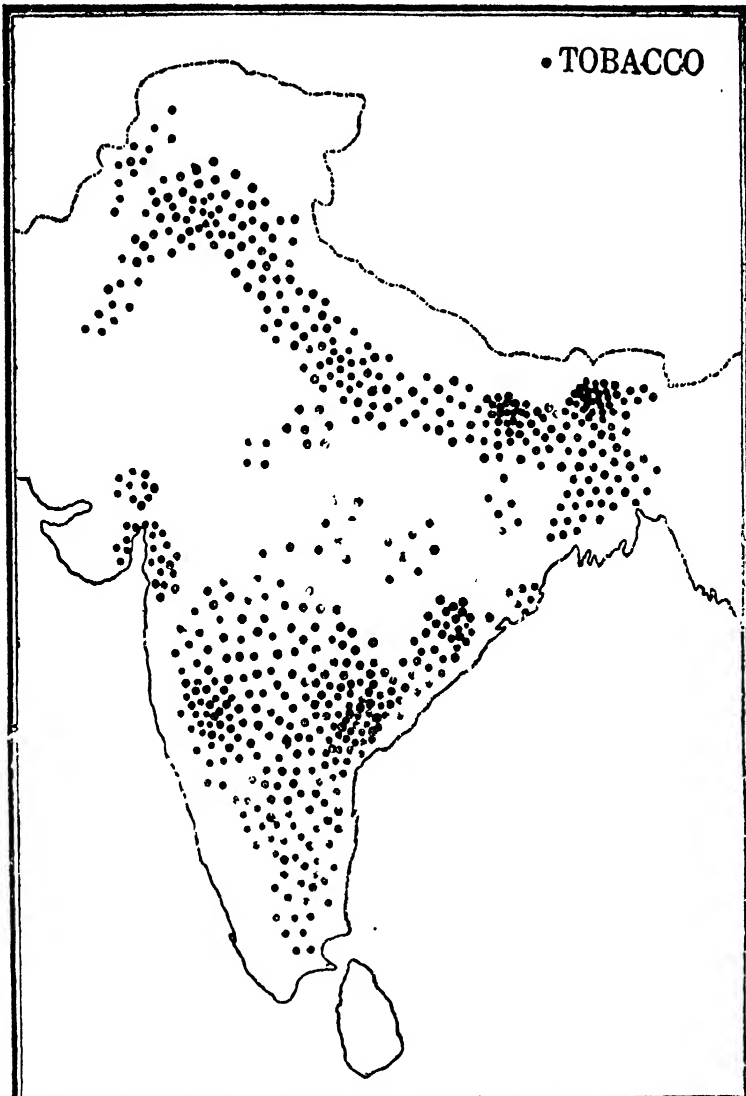

Fig. 28

of flue-curing barns in operation, worked on the principles evolved at Pusa, now exceeds 2,000.

COTTON

Until the partition, Cotton was the most important commercial crop in India. Apart from providing material for four cotton mills, it brought to the cultivator and others engaged in cotton trade in 1935-36 about 34 crores of rupees from export. Out of the total exports of 160 crores of rupees in 1935-36 raw cotton had the largest share, about one-fifth. It was pre-eminently a money crop for the Indian cultivator.

After the partition, however, India is no longer self-sufficient in cotton.

India is still the second largest producer of cotton in the world. The area under cotton in India in 1949-50 was about 117 lakh acres and the production about 21 lakh bales. It is, thus, the sixth largest crop of India from the point of view of acreage. In 1950-51 the exports of raw cotton occupied only the eighth place among the exports from India, while among the imports it occupied the first place.

The comparative importance of cotton is greater in Bombay and Madhya Bharat where it occupies 19 to 20 p. c. of the total net cultivated area, than in other provinces, say for example U. P. where the percentage is only about 1. Even in the Punjab, cotton occupies only 9 p. c. of the total net cultivated area of the province. Apart from the competition offered to cotton by other commercial crops, soil well suited to cotton is not easily found outside the Black Cotton Soil region. This fact is largely responsible for the varying importance of cotton in different provinces of India.

A reference to the cotton map, Fig. 30, and its comparison with the soil map (Fig. 14) will show that the cultivation of cotton in India is closely related to the 'regur soil' (or the Black Cotton Soil). The largest concentration of the crop occurs in Broach, Khandesh, Berar and Tinnevelly, all in the Deccan tableland. Outside the Deccan tableland the crop is found concentrated, though not to the same extent, in the Punjab. This latter area

is, however, essentially an irrigated cotton tract. More than two-thirds of the crop is found in the three Provinces of Bombay, Madhya Pradesh and Madras, and only one-fourth in the alluvial plains of the north. This shows to what an extent the Black Cotton Soil and the associated soils are a boon to the cultivator of the Deccan tableland in producing this money crop.

The soil is the dominant factor in the cultivation of cotton in India.

There are three main classes of cotton soils here :—

(1) Rich black loamy soils, as those of Kathiawar, Gujarat, Khandesh or Karnatak. These are collectively, known as the 'Black Cotton Soils.'

(2) Mixed red and black stony soils, as those of the Deccan, Berar and Madhya Pradesh.

(3) Alluvial sandy soils, as those of the Sutlej-Ganga Basin.

Climate is the next important factor in the cultivation of cotton in India. An idea of the suitable climate is given by the following graph :—

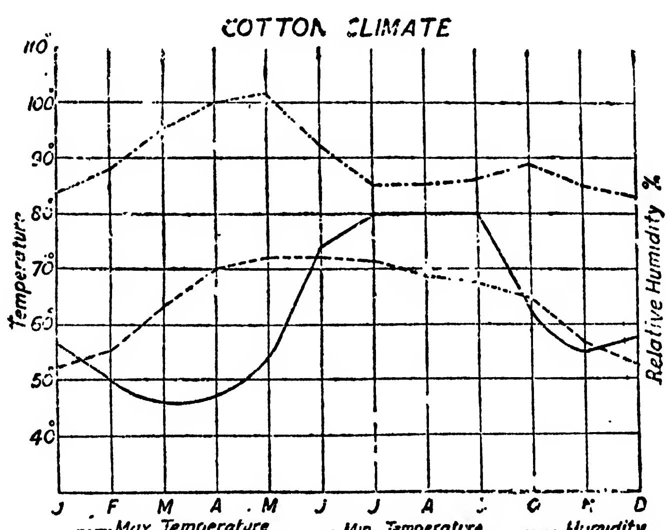

Fig. 29. Metrologicol observations at Ahmedabad.

Three things stand out prominently in the study of this graph :—

(a) The period of growth of cotton, from July to September, is marked by uniformly high temperatures, between 70° and 85° F.

(b) This period of high temperatures is accompanied by high humidity ; generally 80%

This combination of great heat and great humidity is particularly helpful for the growth of the cotton plant.

(c) From about October humidity falls off considerably, but the maximum or the day-temperature continues to be above 80° F. This factor helps the ripening and bursting of the cotton bolls in the sunny skies that result.

It is also clear from the graph that from the month of March onwards the temperature conditions are suitable for cotton cultivation in India, but the moisture is deficient ; as is shown by the downward curve of relative humidity.

The influence of rainfall and the amount as well as the season when it comes, is of vital importance in the cultivation of cotton. If the rainfall is considerable no cotton will be cultivated, even if the soil is suitable. For it encourages vegetative growth rather than fruit from which cotton is obtained.

Provision of cheap labour is another important factor in the cultivation of cotton in India. Cotton-picking must be done by hand ; the picker paying attention to the fully open bolls only.

Southern India, with its two rainy seasons, possesses two widely different cotton crops.

A reference to the rainfall map (Fig. 6) will show that most of the cotton in India is grown in areas which have a rainfall of 20 to 30 inches per year. The first two maps on page 19 indicate that the picking season over the main cotton growing area, that is, from November to February, is practically dry.

The most favoured localities for growing the finest Indian cottons are Surat, Broach, Ahmedabad and Kathiawar.

The main areas for cotton cultivation in the Bombay Presidency are Ahmedabad, Broach, Surat, Karnatak, Dharwar and Khandesh. In Broach, the soil is deep and retentive of moisture. The 'Black Cotton Soil' in some parts is about 5 feet deep. Over the greater part the annual rainfall exceeds 35 inches. The crop is sown as soon as possible after the monsoon sets in. It is grown alone, but where the rainfall is heavy and the soil retentive (as in Broach) rice is grown with it. The principal associated crop with cotton is, however, JOWAR. The flowering begins in October-November and the picking generally starts in January, lasting till March or April.

The cultivation is slightly modified due to the monsoon in Karnatak, Dharwar and Khandesh. If sowings were done in June, as in other districts, the crop would ripen here in the middle of the north-east monsoon and be damaged by rain. To prevent this, sowing usually starts in the latter part of August.

In Khandesh two different types of cotton are grown, the one on the heavy black soil and the other on light soil. The light soil crop yields best with heavy rainfall, and the black soil crop with moderate rainfall.

In Madhya Pradesh sowing of cotton commences with the rains in June. Picking starts in November and is finished by March.

There are two forms of indigenous cotton usually grown in Madras, one depending on the south-west monsoon, the other on the north-east. The former crop is sown between May and July, and the latter between September and November. In Tinnevelly both are sown in the same season, October to November. In the Tamil country where cotton is produced both on black soil and red soil, the crop is sown in black soil during the south-west monsoon when the rainfall is not heavy ; and in the

red soil, which is a lighter soil, during the north-east monsoon when the rainfall is heavy.

Outside the Peninsula irrigation plays an important part in cotton cultivation. Sowing of the crop does not, therefore, wait for the rains in areas where irrigation facilities are available. In areas where such facilities are not present, however, the sowing can be done only with rains. The period of sowing thus varies from March to August. In the Punjab, owing to the danger of frosts, the picking is completed by about January.

Among the indigenous varieties of cotton grown in India, the Broach cotton is the best. The Broach tract extends northwards from the river Par upto the southern boundary of Ahmedabad district. It is one of the most important cotton tracts of India and at one time was the most important. It has now lost its importance considerably owing to the infiltration of inferior varieties into the tract. Among the indigenous varieties Broach cotton yields the finest and the longest fibre. Other important varieties are Omras, grown in Berar, Dholeras grown in Gujarat, Dharwar grown in southern Bombay Presidency, and the Bengals, inferior to all, grown in Northern India. Practically all the indigenous varieties have a short and coarse staple. Certain types of cotton have been imported from foreign countries and crossed with Indian varieties to produce better varieties yielding finer and longer staple. Among these improved cottons may be mentioned the Cambodias grown in south-east Madras, and Punjab-Americans grown in south-west Punjab. With the growing demand for finer cottons in India, all efforts are being made to improve the quality.

In 1943-44 the fine and medium varieties of cotton in India formed about 62 per cent of the total produce of cottons. Most of those improved varieties are long and medium staple cottons, 7/8 inch or above in fibre.

The following table shows the recent progress of different staples of cotton in India :—

STAPLE LENGTH OF INDIAN COTTONS (IN LAKH BALES OF 400. lbs. EACH)

Years		1940-41	1941-42	1942-43	194 -44
Staple :—					
Long :—over 1″	...	1	1·6	2·7	3·6
Medium :—					
1″	...	2·3	2·5	3·1	2.9
7/8″ to 11/32″	...	17·3	22·9	21·4	25·0
Short :—					
11/16″ to 27/32″	...	10·7	11·6	7·3	7·7
9/16″ to 21/32″	...	14·1	11·9	4·6	5·0
17/32″ and below	...	12·2	9·5	6·2	6·5
Total	...	59·3	61·2	42·2	50·9
P. C. of Fine Cottons	...	36%	45%	60%	62%

In spite of the improvement in the Indian staple of cotton, our cotton is far behind the American Cotton. In 1942-43 while the proportion of cottons of the staple of 1 inch or above was only 14% in India, it was as high as 61% in the United States of America.

The following table gives the American staple and may be compared with the above table for India :—

STAPLE LENGTH OF UPLAND COTTON IN U. S. A. IN 1942-43*

Staple	3/4″ or below	13/16 to 31/32″	1″ and above
Bales (Thousands)	61	4722	7574
% ...	5	38·2	61·3

With this end in view, the Government passed in

*U. S. Deptt. of Agr. Cotton Quality Statistics, Nov. 1943.

1923 a cotton Transport Act to prevent the infiltration of inferior cottons into the zones of superior cotton.

Cotton in India is bought and sold, in common with many other agricultural products, on the reputation for quality of its place of growth. The difference in quality of cotton that exists between the same or different types of cotton grown in different tracts has always been a source of temptation to unscrupulous people. Measures have been taken under the above act, and other acts, to eradicate inferior cottons from certain protected zones. There are now seven such zones in Bombay two in the Madras Presidency and one in Madhya Pradesh.

The average yield of cleaned cotton per acre in India is very low, only about 90 lbs. per acre. This is very low when compared with the Egyptian average of over 400 lbs. and the American average of over 220 lbs. It is seen that the yield of irrigated cotton is much better than that of unirrigated cotton. In Madras for example, the average yield of irrigated cotton is 250 lbs. per acre while that of unirrigated cotton is only 73 lbs. Most of the cotton crop in India is, however, unirrigated. By the total of 117 lakh acres under cotton in 1949-50 only about 8 lakh acres were irrigated. The largest cotton acreage irrigated is outside the chief cotton zone. Practically no cotton grown in the Black Cotton Soil region is irrigated. The largest area of irrigated cotton is in the Punjab, South-eastern Madras and U. P.

An important point about cotton cultivation in India is that the cotton fields, unlike those in America or Egypt, in a large majority, produce a grain crop after cotton has been harvested. The field is, therefore, cleared before all the cotton has been picked. The total outturn is affected adversely in years in which the monsoon rains start late. For it must be borne in mind that the sowing of indigenous crop in Black Cotton Soil area particularly, and elsewhere generally, is done with the first monsoon rains. A large proportion of the buds (bolls) of improved variety which produce longer staple, as well as, of

the indigenous cottons, never get a chance to open, owing to the falling off of temperatures in Decem-

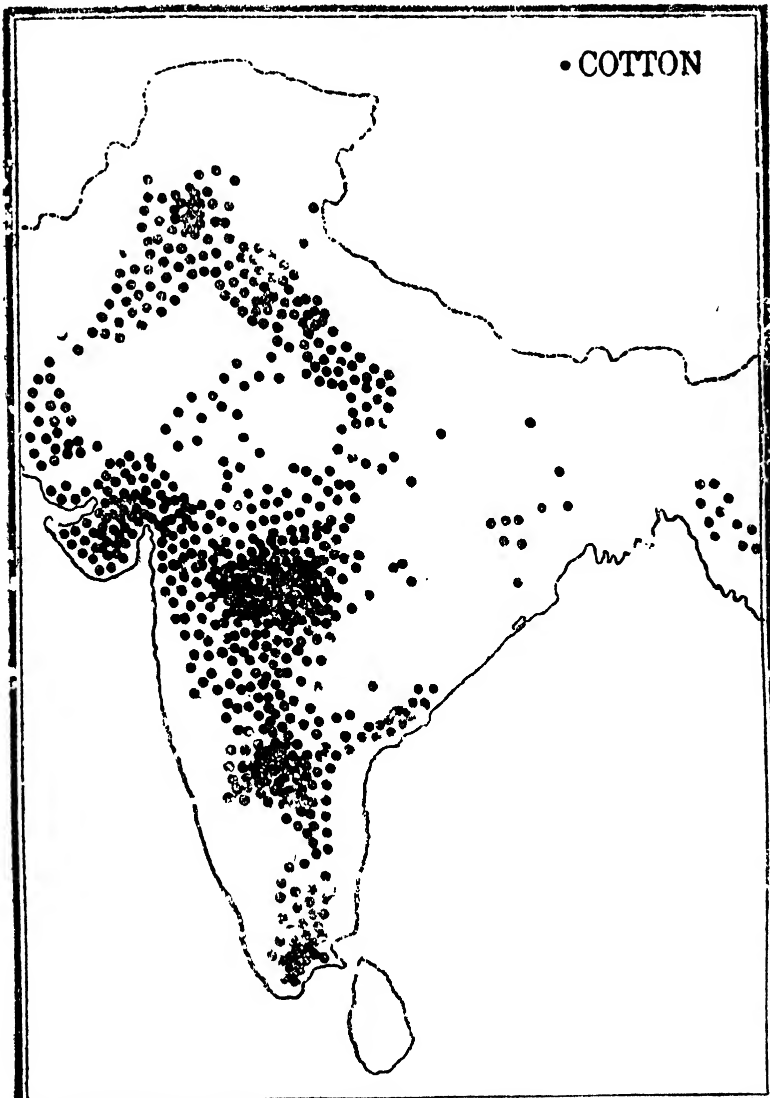

Fig. 30.

ber. The Black Cotton Soil area and the South generally have an advantage in this respect. There the winters are warm with bright sunshine and cotton pickings go on during winter, and even upto July in some cases.

Since the beginning of the present century the home consumption of raw cotton in India has been increasing. The average consumption of Indian cotton in Indian mills during the period 1935-36 to 1937-38 was about 27 lakh bales. In 1950-51 this consumption was 36 lakh bales. The greater part of this consumption is of long and medium staple cottons. In 1938-39, 52 per cent of the Indian mill consumption consisted of long and medium cottons and only 48 per cent of short staple.

Although the United States is the world's leading producer of cotton, it buys some of our cotton. The United States does not grow the rough, white, short-staple cotton used for manufacturing cotton and mixed cotton-wool blankets. Some American cotton is used for the manufacture of cotton blankets, but it is admitted to be not as suitable for this particular purpose as the imported Indian cotton. Moreover, American cotton, unlike the rough short staple cotton, does not mix with wool, and therefore, does not lend itself to the manufacture of cotton-wool blankets which are popular in those parts of the United States where the temperate climate precludes the use of all-wool blankets. Indian cotton is also used to a comparatively small extent as padding in clothing.

The important qualities of short-staple cotton imported into the U. S. A. are its roughness, cleanliness and whiteness. Until recently, China, (especially North China), and India were the two main sources of supply. The Far Eastern hostilities, however, led to the practical elimination of China as a source of supply. This considerably improved the position of Indian short-staple cotton in the United States during the war.

Jute

India has suffered most in the supply of Jute due to partition than cotton, the other fibre crop. Out of the 23

lakh acres under jute in India in 1947, more than 18 lakhs went to Pakistan. The best district for jute, Mymensingh, Dacca, Rangpur, Bogra and Pabna all bordering on the Brahmaputra and affected by its floods, which deposit large quantities of fertile silt, now form part of Pakistan. The old Brahmaputra or the Jumna also provides clearer water for retting the jute than the Ganga. The cultivation of jute decreases towards the south in the Ganga Delta where the land is too low for jute, and towards the west where the rocky ground of the Deccan plateau is more marked than the Ganga alluvium. The distribution of jute in 1949-50 was as follows:—

	Lakh Acres	Lakh Bales
West Bengal	5	14½
Bihar	3	7
Assam	2½	7

Jute is generally grown on raised ground provided by the old or new river levels. In the depressions rice and jute are often rotated. The best quality of jute is obtained from loamy soils. Clayey soils give the heaviest yield, but the plants grown in such soils do not ret uniformly. Sandy soils, on the other hand, produce coarse fibre. Climatic conditions are, however, of more value to jute than the composition of the soil. A hot damp climate, in which there is not too much actual rain, especially in the early part of the season, seems to be best for it.

There are two main varieties of jute plant grown in India, Chinese and Indian. The Chinese variety is chiefly grown on CHARS or mudbanks and islands formed by the rivers. The Indian variety grows chiefly on BIL or completely submerged lands and even on salt-impregnated soils, such as those of Sunderbans. These varieties are, however, found growing together in many parts of India.

The character of the land, whether it is upland or lowland, determines the sowing period of jute. When it is to be grown on lowlands, subjected to flooding, sowing takes place earlier than on raised land. Thus, on BIL lands

it is sown from February to March and on raised land from March to June. The time for harvest depends largely on whether the crop is an early sown or late sown. The harvesting season starts for the earliest crop about June, the average season for all crops being from August to the end of September.

The districts which have a heavy annual deposit of silt have a superiority over others which have little or no silt deposit, especially because manuring is not commonly practised in jute cultivation.

India had a world monopoly of jute before partition. It must be remembered that the largest consumption of jute is for packing material. Cheapness, durability and strength are not found in any other packing material as in jute. Efforts have been made in other countries to find substitutes for jute, but without success. To increase the supply of raw jute in India the area under jute is being increased. The following table gives the figures ;—

	Lakh Acres	Lakh Bales
1948-49	8	20
1949-50	11½	31
1950-51	14	33

The largest increase has been in Bengal, Bihar and Assam. Jute is also being introduced now in Travancore and U. P. (Terai).

Miscellaneous Crops

Besides the crops mentioned above, a large number of miscellaneous crops are cultivated in India. These crops are, more or less, of local importance only. Unlike the agriculture of the Cool Temperate Lands, miscellaneous crops are a special feature of tropical agriculture all over the world.

The cultivation of fruits and vegetables does not form an important part of Indian agriculture. Hardly 2 p. c. of the total net area sown in India is under fruits and vegetables. By far the largest proportion of this area

lies in the Ganga-Brahmaputra Basin. It increases as one proceeds down the Ganga. The U. P. has about 1 p. c. of its total net area sown, under vegetables and fruits, but Bihar has 2.5 p. c., Bengal 3 p. c. and Assam 6·5 p. c.

Among the fruits the mango, the plantain and the coconut are the most important. The mango is a speciality of the wet, alluvial regions of India. The middle valley of the Ganga is more famous for it than any other part of India. Within recent years, the mango plantation has spread in canal-irrigated areas of the western section of U. P. and the Punjab also. In the fertile parts of the Deccan also it has been planted. Mysore, Hyderabad, and Madras have now become important for it now. Outside the Ganga Valley, Bombay is also important for mangoes. The importance of the mango fruit in supplementing the food supplies of the rural areas is considerable. The internal trade in better varieties is now increasing, owing to railway facilities.

Just as the mango is essentially the fruit of the north, the bananas and the coconut are the fruits of the south. The coconut is, however, commercially more important, as it is not so perishable as the mango or the banana. The rainier parts of the Peninsula, especially the Malabar coast, are very important for the banana and the coconut.

Citrus fruits, especially the orange, are grown all over India, but there are certain areas where the fruit is grown more intensively than in others. Among these areas of intensive culture are Nagpur, Assam, and isolated areas in the lower Himalayas, as for example, Sikkim and Butwal.

The deciduous fruits, e. g., the apples, are grown in the drier and cooler parts of the Himalayas, especially near the Punjab. The Kulu and Kashmir valleys are the most famous.

With the growth of the urban population and the health propaganda for eating more fruits the cultivation of fruits has considerably increased within recent years.

Fodder crops also are not important in Indian agriculture. The pressure of population on land and the

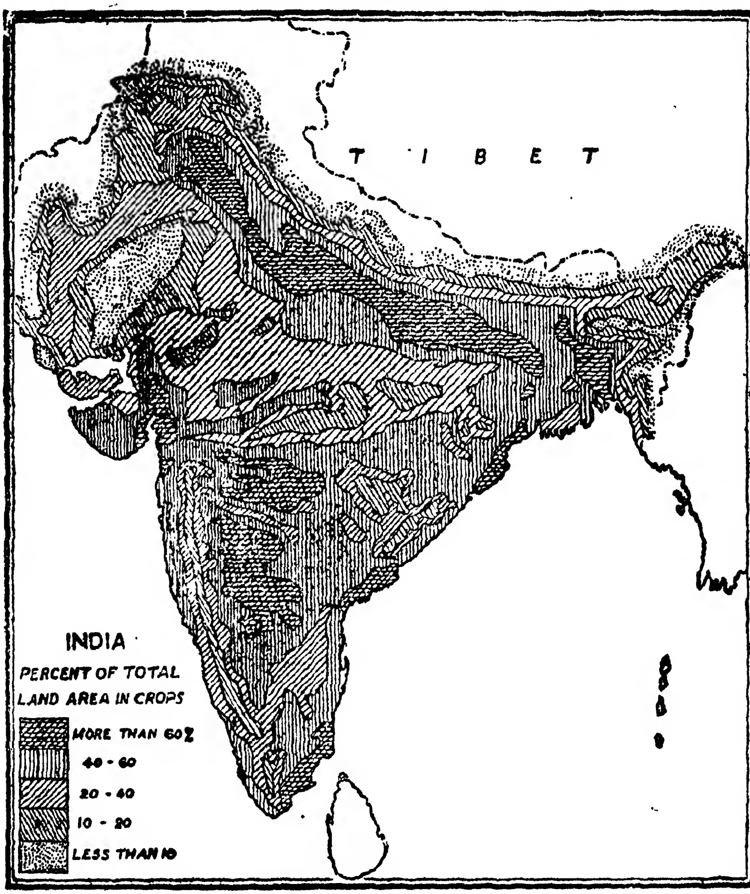

Fig. 31.

insignificance of meat in Indian diet preclude the fodder crops from the general system of agriculture here. The Indian cattle on whom rests practically the whole of the burden of agricultural operations are given as fodder the by-products of the main crops. They are, therefore, weaker than the cattle in Temperate lands where the systematic cultivation of the fodder for cattle is as important as the food crops for man. The peculiarities of

the Indian climate do not enable hay-making. The Indian grasses, growing rapidly in hot and moist season, become tough and are not succulent so that the cattle generally do not relish them when they are dry. Besides, the area left over for grasses is generally infertile where grasses are short and not fit for hay-making.

The Dairy Industry or other forms of animal industry, like meat packing, have not developed on any large scale in India. The urban population which offers the largest market for these industries is not large in India. The number of animals yielding milk is, however, very large in India. These animals are kept for breeding bullocks and buffaloes that are needed for agricultural operations. Their main purpose, therefore, is not milk production but to help agriculture. The milk yielded is used mostly for making "GHEE' which is sold in cities. Near the towns, a little dairying is also practised. It has been estimated that India produces about 171 lakh ton milk, of which about half (43%) is converted into Ghee. The quantity of ghee made is estimated to be about 4½ lakh tons. For want of large grazing areas, the dairy cattle are generally stall-fed. This is particularly so in large cities like Calcutta and Bombay. The largest number of milk-yielding animals is in U. P., where the area under cultivation is the largest in India and, therefore, the need for cattle help is very great.

The animal most used for slaughter for meat is the goat. That is the only service that this animal can render us in India. The largest number of goats are in U. P. and Madras. The number of sheep in India is about 50 millions, but owing to the hot climate they do not produce good or fine wool here. In the Himalayas, where alone good wool is produced in India, the goat is more important as a wool producer than sheep. The following table gives the numbers of some animals in India.

Bullocks	60	Millions
Sheep and Goats	50	,,
Cows	35	,,
Buffaloes	20	,,

The Sutlej-Ganga Basin with its fertile soil, abundant rainfall and adequate facilities for irrigation naturally has the largest proportion of its area under crops. The importance of the various provinces lying in this basin in respect of the most important crops of India has been shown along with the discussion of crops. The map on page 130 (Fig. 31) shows the agricultural importance of different parts of the country. This map clearly brings out the importance of the above Basin.

Agricultural Productivity

The above discussion has brought out two important points about Indian agriculture; the pressure of population on land and the general low yield per acre. The pressure of population has been increasing steadily due to the increase in India's population. This has naturally given cause for anxiety and the question has been raised recently whether India's agricultural production can be increased.

Agricultural production in India can be increased along two directions:—

(i) Increased yield from existing fields.

(ii) Cultivation of new lands.

(i) Increased yield from existing fields is possible only at a great expense of money. Intensive use of natural and artificial manures alone can considerably increase the yield from the soil. The money necessary for buying artificial manures, mostly from foreign countries, is lacking in India. The Indian farmer is too poor to afford this. The Sindri works are expected, however, to ease the situation in this respect. The factory at Sindri will produce about 3½ lakh tons of ammonium sulphate annually. But the total requirements of this manure for this country have been estimated at 15 lakh tons annually. The use of natural manure can be increased slightly by a change of habits. At present cow-dung is used partly as domestic fuel. This practice can be changed by using

soft coke as a domestic fuel. It is not, however, easy to change overnight the habits of a people formed during centuries. The Government is making efforts to convert into manure other kinds of refuse as well. Night soil and cow-dung and farm refuse generally are being made into 'COMPOST.' In 1949-50 about 10 lakh tons of compost were made in urban areas by the municipalities. About 50 lakh tons of compost was made by the villages. Thus the supplies of manure are being increased in India. Mechanization of agriculture has also been recommended for increasing food supplies in India. It has been pointed out that about 730 lakh Indians produce from their agricultural land only as much food as about 70 lakh Americans do from theirs. The advantage of the Americans is said to be due to the farm machinery used in America. To modernize Indian agriculture, therefore, the Government of India has started a Central Tractor Organization which possessed in 1950 about 280 tractors with additional machinery. These tractors are working in different Provinces (States) of India helping the farmer to produce more from his land. In 1949, a loan for the purchase of tractors was obtained by India from the International Bank for Reconstruction. The Bank laid down the condition that the tractors purchased out of that loan should be used at least for part of the time for the cultivation of food crops.

The use of tractors is becoming popular in India since the Second World War. The scarcity of farm animals and the higher cost of their maintenance, together with the scarcity and higher wages of agricultural labour naturally encourage mechanization of agriculture.

An increase in the yield is also possible by using improved seed and better tillage with improved agricultural implements. Increased irrigation will also help.

Efforts are being made by the Imperial Council of Agricultural Research to bring 22 million acres of land in the famine zone of India under improved cultivation by dry farming.

A comprehensive scheme of research in dry farming was formulated by this Council in 1930. But it was not until 1933 that funds were available for this purpose, and experimental stations were started in the provinces of Bombay, Madras, Hyderabad and the Punjab. In Bombay, improved methods were tried on the cultivators' own fields and the yield obtained was about double that obtained by the cultivator by his own efforts. The results obtained at Sholapur and Bijapur showed that the average grain yield under the improved method after five years was about 90% higher than the one obtained by old methods.

(ii) Most of the suitable land for agriculture has already been occupied. There is, therefore, very little scope for finding new land for agriculture. The only areas where new land is available are the semi-deserts in the Punjab where the soil is fertile, but where cultivation is not carried on at present for want of irrigation facilities. Gradually as these facilities are extended, some land will become available for agriculture. This is the only important source of increased agricultural production in India.

Reclamation of barren lands may also be attempted, but here also the expense involved will not justify the small addition to the agricultural land in India. Experiments have been made, and some are still in progress, in U. P. and the Punjab for reclamation of the alkaline lands. The results have not, however, been encouraging.

Formerly, a Land Reclamation Department had been established by the government of the Punjab to carry on systematic reclamation of land affected by 'thur' and 'kallar.' Experimental work of this kind had been going on in the Punjab for more than thirty years. The success of this experimental works was established only in 1939 when five villages near Sukheki, on the Lower Chenab Canal, were selected for a trial. The success of this trial led to the formation of the above Department which gradually spread its activity to the whole province. The method used for reclamation of land was simple. The

land was first flooded to wash down the harmful salts to the sub-soil. Rice was then grown in the flooded area. This was followed by a leguminous crop which generally reclaimed the soil.

India's Food Problem

The population of India is increasing at a considerable speed, but the area under food crops in India is either steady or decreasing owing to a part of it being transferred to the important commercial crops. The problem of food supply is, therefore, becoming acute here every day.

The total population of India in 1950-51 is estimated to be about 357 millions. The adult equivalent of which, according to the Government of India is about 307 millions. At the rate of about half a seer of foodgrains per day per adult would require about 500 lakh tons per year. The total production of cereals in 1950 was about 458 lakh tons. Out of this a deduction of about 12½% is allowed by the Government for seed and wastage. The total amount of foodgrains thus available in 1951 may be estimated to be about 401 lakh tons. The average share available per adult thus works out at a little more than six chhataks per day. To provide half a seer per day about 99 lakh tons of cereals more are needed NOW. But the population of India is increasing every year by about 1 per cent. Every year there are about 50 lakh fresh mouths to be fed. The shortage of food must, therefore, increase if there is no corresponding increase in cereal output here* The Government of India have launched a Five Year Plan in which it is proposed to feed a population of 380 millions in 1956-57, giving every adult a little more than seven chhataks per adult, instead of six chhataks

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*Cereal Production and Imports (Lakh tons.)

	Production	Imports
1948	442	23
1949	442	28
1950	458	27

as at present. In this plan imports of about 30 lakh tons of cereals every year have been provided for.

The Government of India have accepted the responsibility of providing grains at controlled price to about 114 millons, or about one-third of the total population of the country. Of this total, about 45 millions are getting assured rations in the towns. The largest rationed population in India is in Madras State where rice is in the greatest demand.

The solution of the food problem of India may be found along the following lines :—

(i) Changing the habits of the people, so that more meat and fish may be included in the diet of the people.

(ii) Better exploitation of Indian fisheries. The fisheries of India have been neglected so far. Bengal is the only province where some attention has been paid to develop the inland fisheries, but no effort has been made here to organise the marine fisheries of Bengal. Madras is the only province in India where considerable work has been done to develop the marine fisheries. Large amount of fish are caught along the Coromondal Coast by fishermen going out in catamarans (small boats made by tying with ropes a number of planks) or even in small steam boats. Considerable quantities of fish are used in Madras for extracting fish oil, which is rich in vitamin A and is sold as 'cod liver oil'. But Madras has neglected her inland fisheries altogether. In the province of Bombay, chiefly to meet the large demand for fish in the city of Bombay, also steps have been taken to develop marine fishing. Some ice factories have been started on the coast to supply ice to the fishermen and enable them to carry the fish in cold storage to Bombay. Apart from this small development of marine fishing, a few hatcheries have been started in some hill-stations to provide fishing for the visitors. Notable hatcheries are found in Kashmir, Kulu Valley and the Nilgiri hills. The most important fish bred here is the trout.

(iii) Changing agricultural practices so that more fodder could be grown for cattle or goats which could supply meat or milk. Root crops and lucern can be grown in larger quantities as rotational crops, leading to soil fertility and greater supply of cattle fodder. Increased meat and milk supply can then take the place of cereals raised for our food from the soil. In order to bring about this change, however, better facilities for irrigation will have to be provided.

(iv) More manuring of the soil to enable greater yields of crops.

(v) Scientific improvements in our agriculture to enable better yields, or reclamation of lands at present lying barren.

(vi) Restriction of the area under certain commercial crops like cotton and jute whose market is mostly outside India and where the competition has become now serious.

(vi) Bringing new areas under cultivation by extending irrigation facilities and clearing forests where.necessary.

No solution, however, can be effective until the people and the government take the problem seriously.

Agricultural Regions of india

Considering the soil and rainfall distribution, as given on pages 66 and 8 respectively. India can be divided roughly into the following agricultural regions :—

1. The Lower Ganges Region.
2. The Upper Ganges Region.
3. The Sutlej Region.
4. The Desert Region.
5. Tht Black Soil Region.
6. The Crystalline Soil Region.
7. The Coastal Regions.

In the case of the first two regions, which include the Indo-Gangetic basin, the basis of division is the amount of rainfall. While in the case of the last four divisions, which are in the Peninsular region, soil determines this division.

1. THE LOWER GANGES REGION may be said to include Bengal, Assam and certain parts of Bihar. This region is characterised by an abundance of moisture. Over most of the area the rainfall varies between 75 and 100 inches during the year; the larger proportion of it coming during the summer months of June to October. (Refer to the rainfall maps on pages 18 and 19). Uniformly warm temperatures are another climatic characteristic of this region.

The region is occupied by the lower ends of several rivers and naturally, therefore, comprises of low ground. River banks and depressions are the two most important physical features of the area.

Composed mostly of the alluvial soils brought down by the rivers, this region has a high agricultural value. Except in the lower dalta of the Ganga and in some parts of the Burdwan district, the proportion of the area under crops to the total area is very high.

The most dominant character of agriculture in this region is that there are only a few crops grown over large areas. The number of crops grown is not large. Rice, jute and tea are the outstanding crops. Oilseeds, sugarcane and cotton are other important crops of this region. The climatic conditions, as well as the large population to be fed, naturally make rice the most widespread crop of the region. Rice dominates the landscape as also the outlook of the people. This need for growing rice in this region wherever possible, leaves very little land for commercial crops. Fig. 18 on page 81 shows to what an extent rice is important in the agriculture of Bengal and Assam. Roughly four-fifths of the cultivated area is under this one crop.

Irrigation plays the least part in the agricultural operations of this region. Irrigation canals or wells for irrigation are almost unknown in this region. Whenever there are long breaks in the monsoon rains, some irrigation by lifting water from the numerous depressions, which have almost always some water, is practised.

As manuring is not common in rice cultivation, and as rice is the most widespread crop, the use of manures (except in tea plantations) is not important in this region. The annual floods, in fact, supply such large quantities of new, fertile silt every year to the fields that the soil naturally recoups its fertility without any manure. In tea plantations, however, the use of manures is common.

Owing to the large agricultural population in relation to the area fit for cultivation, the fields are generally very small in this region. These fields are cultivated with the help of bullocks, the use of agricultural machinery being almost unknown here. Most agricultural operations are done by hand labour, which is a characteristic feature of all rice lands. The stagnant water in the depressions and in the ricefields breeds malaria which saps the health of the agricultural labourers and agricultural labour is, therefore, not very efficient here. During the last war to protect the soldiers much was done to eradicate malaria by providing drainage canals and spraying of insecticides.

Weeds are very common in the fields here. A very serious problem facing agriculture in some parts of this region, specially Bengal, is the spread of the WATER HYACINTH. This weed takes root in the stagnant water and is difficult to eradicate. It completely chokes any crop growing in such water, and thus makes large areas, formerly good agricultural land, unfit for crop cultivation. The Government is spending a good deal of money in research work to free the land from this curse. The reeds are also a menace to cropland.

The lack of good fodder supply is the cause of the dearth of good and healthy animals in this region. Rice which is the most widespread crop here, does not yield a suitable or nourishing fodder for animals. The other important crops grown here do not yield any fodder at all.

Besides, the climate and soil here do not favour grasslands. The depressions are almost always covered with

water, and so grass cannot grow there. The uplands or river banks are valuable for arable farming and cannot be left over for grass. The areas unfit for agriculture are also unfit for grass. For example, the lower delta is subjected to saline tide water which does not permit the growth of suitable grass for fodder. The crystalline soils belonging to the peninsular class are too porous for the growth of grass.

Dairying or meat production are, therefore, not important in the agriculture of this region.

2. THE UPPER GANGES REGION is by far the richest agricultural region in India. It comprises parts of Bihar and Utter Pradesh. Ordinarily, the rainfall in this region is neither too much nor too little for agricultural purposes. The seasonal character of the rainfall distribution, however, makes irrigation an integral part of the agriculture of this region. There is a clearly marked rhythm in the winter and summer temperatures. The winters are cool, while the summers are hot. Based on these temperature differences, the crops grown in the region fall into two distinct classes. The RABI crops are suited to winter conditions, while the KHARIF crops are suited to summer conditions.

As seen above, irrigation plays an important part in the agriculture here. This irrigation is, however, confined entirely to winter crops which are grown when the season is characteristically dry. Wells predominate in the irrigation of this area. Nowhere else in India are there better geographical conditions for well irrigation than in this region. The high water-table, the occurrence of claybeds in the sub-soil, the predominance of saturated sand and the filtering of water from the more rainy areas of the Himalayan foot-hills—all these provide the most favourable geographical conditions for well irrigation.

Even though well irrigation is the most characteristic form of irrigation in this region, canal irrigation is not far behind. The most important canals of the region, the Ganga Canals, the Jumna Canal and the Sarda Canal, irrigate considerable areas of land.

An important feature of the agriculture of this region is the multiplicity of crops grown here. There is hardly any other part of India where the variety of crops grown is so great as it is in this part. This multiplicity of crops depends, of course, on the absence of extremes in agricultural conditions. There are moderately varying conditions of rainfall, temperature and soils which enable a large number of crops with varying requirements to be grown in this region.

Considerable use of manures is another important feature of the agriculture of this region. The importance of wheat and sugarcane, which need considerable nutrition from the soil in order to yield well, makes, the use of manures incumbent. The manure used consists largely of the animal refuse and domestic refuse. The large number of animals found in this region is, thus, a great help in providing animal manure. The fact that a large amount of cow-dung is used as a domestic fuel in a region where the demands on soil fertility are so great is a great agricultural drawback. Cow-dung is a valuable manure. Its use for any other purpose, therefore, deprives the soil of a source of fertility.

The most important crops of the region are wheat, rice and sugarcane. There are distinct areas in which these crops predominate ; as for example, wheat dominates the western section, rice the eastern section and sugarcane the middle section of the region. These crops occupy generally the best land. The inferior soils are given over to the cultivation of poorer crops, like barley and millets, etc.

The occurrence of large areas of pastures, especially in the lowlands near the numerous rivers, enables a large number of cattle and other animals to be kept. Most of the cattle are meant for agricultural operations. Dairying is, however, being encouraged in the neighbourhood of large towns.

Due to the vagaries of rainfall, large parts of this region suffer now and then from famines. The 'famine

zone' is marked particularly in the areas that adjoin the Peninsular region. The famines cause the greatest damage to the poorer food crops, and hence the greatest suffering to the poor. For the more valuable crops are generally grown in areas which are well supplied with irrigation facilities. Rice suffers most during famines, as it requires the greatest amount of moisture and is grown in areas where obviously, canal and well irrigation are least developed.

Fields in this region are very small. The agriculturists are generally very poor, due to the great pressure of population on land. The presence of the industrial town of Kanpur, and the towns manufacturing sugar, makes it possible for the agriculturists of this region to supplement their income from agriculture by working in these towns during the slack season when the agricultural operations do not need them.

The presence of large towns has offered an incentive for growing fruits and vegetables in this region on a fairly large scale. Large quantities of potatoes and cauliflowers are grown in the area round about Banaras and Ghazipur. These vegetables find profitable markets even in distant places like Calcutta.

3. THE SUTLEJ REGION, comprises the Punjab, and Pepsu. The Sutlej river and its tributaries play the most important part in the agricultural development of this region. Except in a small strip lying near the foot-hills of the Himalayas, where the rainfall is enough, the whole agriculture of this region depends upon irrigation. Irrigation is, therefore, the outstanding fact of this region.

The contrast between winter and summer temperatures is marked here more than in the Upper Ganga Region. The winter crops, like wheat, therefore, flourish here better than in other parts of India. The winter rainfall in this region is enough for the growth of these crops.

The soils of this region are mostly alluvial silt which approach desert conditions whenever the rainfall is defi-

cient. The hot and comparatively dry climate of the area causes considerable evaporation of water. In some cases this evaporation draws to the surface salts from the sub-soil. These salts lie as a crust over the soil and destroy its agricultural usefulness.

Wheat, cotton and sugarcane are among the most important crops of the region. The cultivation of fruits on the foot-hills of the Himalayas is a characteristic feature of the agriculture of this region. Canal irrigation is the most important feature of this region.

The proximity of the Sind Rajputana desert, which is the chief breeding ground of the locust in India, makes this region specially liable to attack by locusts which may cause, therefore, very serious damage to crops in this region. Large sums of money are being spent every year by the Government to eradicate the locust-menace to this region.

In the area near the Himalayas where the rainfall is adequate, the variety of crops grown is considerable. But in areas where canal irrigation is the chief source of agriculture, the crops grown are few in number.

The fields in this region are generally large and the cultivators here are better off than in any other part of India. The dry climate of the region makes them sturdy and so they labour on their fields harder than any other cultivators in India. The riches of the Punjabi cultivator are, therefore, the proper reward of his efficient and hard work on the fields.

The pastures in this region are poor due to the dry climate. There is consequently a dearth of fodder for cattle and other animals in the region. The cultivators, however, have enough land and there is not much pressure of population on land. This enables them to devote some portion of their land, specially to growing fodder crops. The most important fodder crop grown in this region is lucern. There is no other part of India which has as great an acreage under lucern as this region. Fed on such a nutritive fodder as lucern, the cattle in this region

are strong and healthy. Some of the Punjab breeds of cattle, like the Hissar or Hariana breeds, are famous all over India.

4. THE DESERT REGION of India includes certain parts of Rajputana. This desert is not a wholly barren area where nothing would grow. On the contrary, wherever water is available for irrigation, agriculture is carried on. This agricultural land naturally occurs in river valleys where well irrigation helps certain crops to grow.

Agricultural areas in the Desert Region occur in isolated localities. They are not extensive. Wherever such areas occur, settled population is found. The most important crops grown in this region are those that require the least amount of moisture and yet can endure the great heat of the region during summer. Small millet (BAJRA) is such a crop and is, therefore, grown extensively in this region wherever cultivation is possible. In favourable localities, wheat is cultivated during winter.

In hilly areas in this region a few animals, especially goats, are reared on the poor pastures.

This region provides the chief market for the surplus of agricultural produce in the neighbouring regions, as it does not produce enough itself. The cultivators in this region are poor, though hardy. As its name implies, this region is the poorest of all agricultural regions of India.

5. THE BLACK SOIL REGION covers a large area in the Peninsular region. This region coincides with the REGUR or the Black Cotton Soil of India. It extends over parts of Bombay Presidency, Central India, Central Provinces and Berar and Madras Presidency. As the region extends over a large area, there are considerable local differences of climate and soil. Generally speaking, the region gets about 30 to 40 inches of rainfall. The temperatures are moderately high throughout the year.

Agriculture over large areas of this region is carried on by rainfall without much irrigation. The character of the rivers in this region is such that they cannot be used

to any extent for irrigation, except in a few localities as in Gujarat. These rivers generally flow in gorge-like valleys far below the general level of the country. Lifting of water is, therefore, difficult for irrigating the fields. These rivers, unlike the rivers of the north, do not have their sources in mountain snows. Their water supply, therefore, is dependent entirely upon rainfall. They are mostly dry in the dry season. For well irrigation also the conditions are not generally favourable. It is only here and there that wells can be bored with any hope of getting water. These wells often dry up after giving water for some years. It is only in areas where the Black Cotton Soil is very deep that well irrigation becomes important. Thus, irrigation is not an important feature of this region.

The most important crop of this region is cotton. It is, however, not grown everywhere in this area. Only those places where the soil is deep enough to supply enough nutrition and is retentive of moisture specialise in cotton cultivation. Elsewhere, poor food crops like jowar and bajra (millets) are the important crops. Due, however, to local differences, a great many other crops are also grown in this region. Among these minor crops, mention must be made of wheat, the cultivation of which is fairly important in the Malwa Plateau and in the valley of the Narbada. Sugarcane is another such crop which is grown in isolated favourable localities.

The Black soil Region is varied by the occurrence of hilly areas here and there. The neighbourhoods of these hills generally provide extensive though poor pasture lands. On these pastures numerous cattle and goats are reared. Such pastures also occur in the neighbourhood of rivers whose banks are often a maze of ravines.

The fields are generally large in this region, but the soil is not equally fertile everywhere. Irrigation facilities are also not abundant. The yield from these fields is not, therefore, high. The cultivators are, therefore, generally poor in this region.

6. The Crystalline Soil Region also extends over a large section of the Peninsula. It occupies parts of the Bombay, Madras, Madhya Pradesh and Orissa States.

This region is covered by red and yellow soils, and in some places also by laterite, which are characteristic of areas composed of very old rocks. This part is geologically the oldest in India. The soils derived from these old rocks are generally infertile. This region, therefore, is markedly a region of poor soils. Continuous agricultural tracts as one comes across in the Gangetic Valley are, therefore, rare in this region. The topography of this region is broken or undulating. There are isolated blocks of hills belonging to the Satpuras and the Eastern Ghats. There are also the plateaus of Chhota Nagpur, Mysore and Hyderabad. This fact further reduces the area of agricultural land here. Valuable agricultural lands, however, occur in the depressions and in the river valleys wherever they widen out. In such areas there are deep deposits of finer soils which are well suited to the growing of valuable crops like sugarcane and rice. On elevations and slopes the soil is generally coarse and not very deep. In such areas only poorer crops can be grown.

The temperatures are high throughout the year and the differences between winter and summer temperatures is very little. The rainfall is copious, varying from 30 to 50 inches per year. Over most of the area rainfall comes both during summer and winter, but rainfall falls below the normal in this region more than anywhere else in India. This brings the famine conditions which are so frequent here. The ravages of the famines are very serious particularly as the land is comparatively poor in fertility and the cultivators are not able to store large reserves of food. Even a slight departure from the normal rainfall causes distress, especially as the moisture requirements of crops in this region of high temperatures are great. These requirements can seldom be satisfied from other sources as the facilities of irrigation are not

abundant. Famine must, therefore, be regarded as a chronic problem in this region.

Millets, particularly BAJRA, are the most widespread, because they are suited to the climatic conditions and the poor soils of this region as no other crop. Other important crops are oilseeds (groundnuts), cotton, rice and sugarcane. The absence of wheat cultivation to any extent, due to the poor soils and hot climate, is a marked feature. In specially favourable area on the slopes of the mountains plantations are an important feature in this region. Tea, coffee, rubber and spices are produced in these plantations. Tank irrigation is important in this region.

The broken character of the land and infertile soils generally give rise to extensive pastures. These are, however, poor and can support only goats in large numbers. Cattle are not so important on these pastures as goats.

The fields are rather large, but the general infertility of the soil does not enable the cultivator here to get big yields from these fields. The cultivators in this region are generally poor. They are not very healthy and strong as the climate of the region causes various maladies. Hook-worm disease is very widespread in this region. This disease gradually saps the vitality of the people and makes them weak.

7. THE COASTAL REGION is the smallest in extent. It includes the coastal plains lying on the eastern and western coasts of India. The plains on the east are wider than those on the west. These coastal plains comprise mostly of the river deltas which are larger on the eastern than on the western coast. These plains are usually hot and moist. The soils are fertile throughout except in the neighbourhood of the sea where sand lowers fertility. The fertility of the soil has been increased now by the provision of canal irrigation in the larger deltas.

Rice is the most dominant crop though sugarcane, tobacco, and cotton are also grown wherever conditions favour.

The fields are generally small, but the rich soil enables the cultivators to raise large crops from their fields. The cultivators are not as poor as those in other agricultural regions comprised within the Peninsula.

QUESTIONS

1. Bring out clearly the geographical reasons given for saying that it is possible to increase the agricultural output of India.
2. Discuss the distribution of rice in India.
3. Describe the physical and economic conditions associated with the production of sugar in India noting recent developments.
4. Compare and contrast the agricultural conditions in the Punjab and Bengal, with special reference to natural and artificial water supply.
5. Describe in relation to soils and climate the distribution of the principal crops of Peninsular India.
6. What are the chief oilseeds produced in India? Where and whence are they exported?
7. Give an account of the production of oilseeds in India. Illustrate your answer by a sketch map. Which of the oilseeds are exported and to which countries? In each case mention at least one port of export. Describe the uses to which oilseeds are put in European countries.
8. Draw a map of India and mark thereon the principal areas of the production of :—Rice, Wheat, Cotton, Wool, Silk, Jute, Tea, Tobacco, Linseed and Groundnuts.
9. Under what geographical conditions is wheat grown in India? How far do these conditions differ from those in the leading wheat-producing countries of the world?
10. What is the importance of cotton cultivation to the Indian cultivator? What are the main tracts growing cotton in India? How far do the geographical conditions differ in them?
11. Why is the cultivation of the following crops almost confined to certain localities :—

    Jute, Jowar, Sugarcane, and Tea?
12. What is the position of oilseeds in Indian agriculture? Point out the geographical conditions under which the main oilseeds of India are grown.
13. Why is India so important agriculturally? Discuss.
14. Why is the Dairy industry not so important in India as in Europe or America?
15. What are the essential conditions of the cultivation of fruits and vegetables? How far are these conditions fulfilled in India?
16. Divide India into agricultural regions, and describe the agricultural conditions of any one of them.

CHAPTER VI

IRRIGATION

The importance of agriculture to the people of India compels them to protect the soil against damage and to get as much from it as possible. Irrigation is one of the methods whereby Indian agriculture is assured of stability. There are two features in Indian rainfall which make irrigation necessary. These are: (a) Uncertainty of rainfall distribution, both in time and place, and (b)

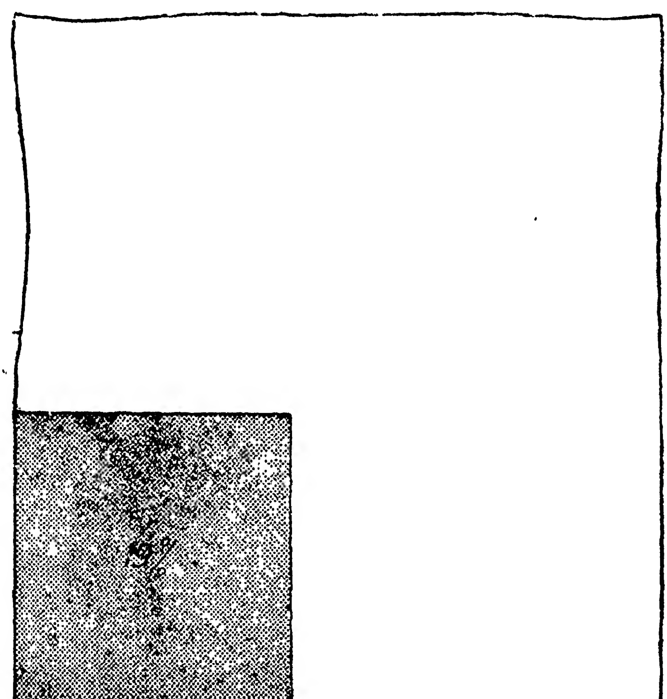

Fig. 32. Cultivated Area Irrigated.

irregularity in distribution through the year, i.e., the concentration of practically the whole of the rain in a

few months, leaving the rest of the year dry. Temperatures in India being suitable for the growth of crops throughout the year this shortage and uncertainty of moisture supply is a great hindrance and is partly removed by irrigation.

India occupies the most important place in irrigation in the whole world. Roughly, about one-third of the total irrigated area of the world lies in India.* Some of the largest canal systems of the world are found here. All this is because nature has endowed India with certain advantages that are seldom to be met with in other parts of the world on such a large scale.

In spite of it, India is not able to satisfy her entire demand for irrigation. It is only a small fraction of her total cultivated area that gets irrigation. Fig. 32 shows that only about one-fifth of the total cultivated area in India is able to be irrigated.

The poverty of the people and lack of irrigation water over certain parts in India are obviously the reasons for this small proportion of irrigated area. Most of the irrigated area in India (about 63%) lies in the Indo-Gangetic Valley where the facilities for irrigation are the greatest. Owing to the fertility of the soil and the cultivation of certain important crops like sugarcane here, it pays to irrigate in .this valley. The accompanying diagram shows the distribution of the irrigated area in various provinces.

*(Figures in lakhs.)

Serial No. of Country.	Cultivated area.	Irrigated Area.	% of Irrigated to cultivated area.
India ...	2494	489	19
Pakistan ...	450	300	67
U. S. A. ...	4510	225	5
Australia ...	206	140	7
Egypt ...	71	55	77

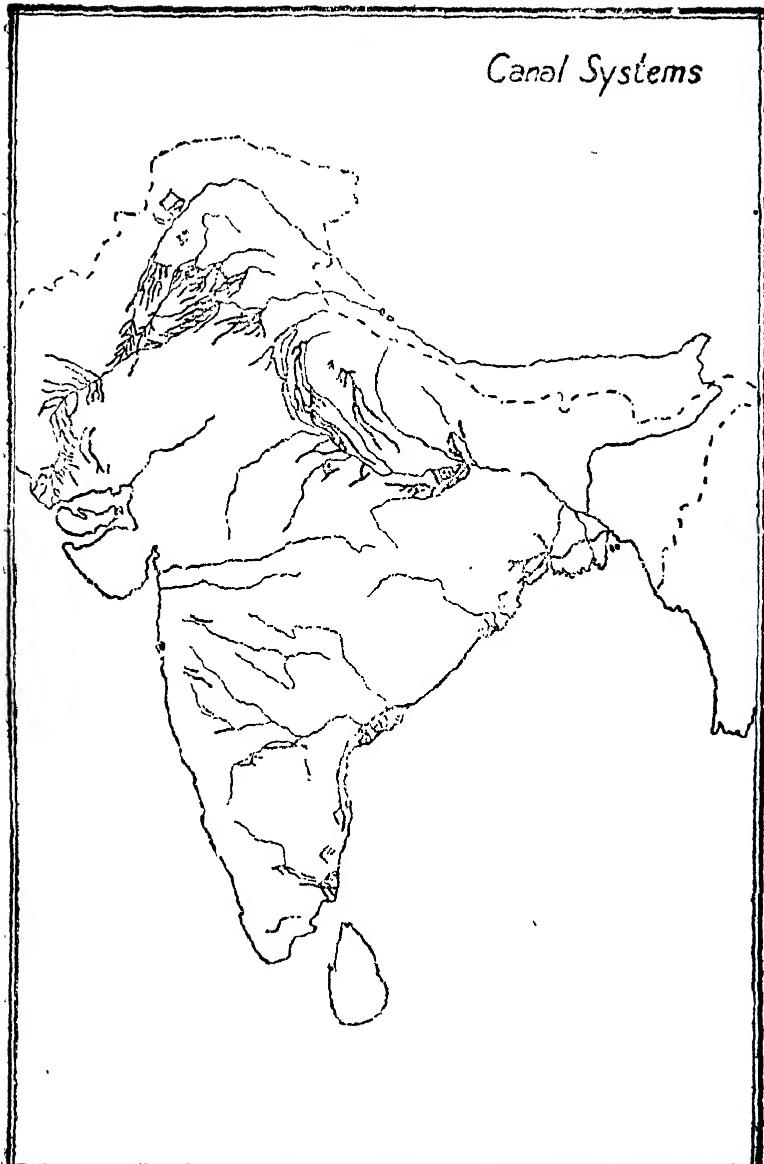

Fig. 33. Showing importance of the Indo-Gangetic Basin in Central Irrigation.

Irrigation is needed in India :—

(i) for the whole country to grow Winter or 'Rabi' crops during the long dry season, characteristic of monsoon climates;

(ii) for those arid regions in which the normal rainfall is too meagre to allow agriculture without being regularly supplemented by artificial irrigation; the entire agriculture of such regions depends on irrigation, as in some parts of Rajasthan and the Punjab.

(iii) for those areas in which the rainfall is precarious, so that when it fails millions of people have to face misery and starvation.

It is only in certain areas like Bengal, Assam, and the Submontane Terai regions, where the moisture supply is always abundant that irrigation is not needed.

Geographical Advantages

The geographical advantages for irrigation in India are :—

(a) the perennial rivers of the north, with their sources in the perpetual snows of the Himalayas;

(b) the gradual slope of the plains, so that the canals taken out from the upper courses of the rivers easily irrigate the land in their lower valleys;

(c) the absence of rocky ground in the plains facilitates easy cutting of canals.

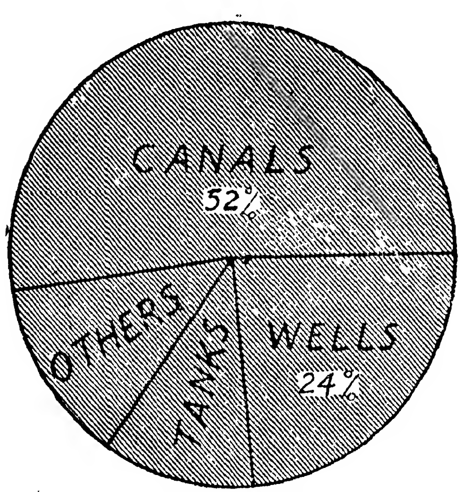

Fig. 34. Sources of irrigation.

(d) the fertile soil which gives the greatest returns to irrigation; and

(e) clay-beds, deep in the sub-soil, which act as reservoirs for the rain water which sinks through the porous alluvium of the plains and which is later tapped by wells.

The following table shows that largest irrigated areas in India are in U. P., Madras and the Punjab :—

Irrigation (lakh acres), 1947-48.

	Govt. Canals	Well	Tank	Total
U. P. ...	47	51	...	118
Madras ...	44	19	32	120
Punjab ...	32	15	...	51
Bihar ...	...	...	...	48
West Bengal ...	...	...	...	20
Pepsu ...	...	...	...	19
Orissa ...	...	...	...	16
Bombay ...	...	...	...	15
Rajasthan ...	...	...	...	15
Hyderabad ...	...	...	...	13
Mysore ...	...	...	...	11
Travancore ...	...	...	...	11
Assam ...	...	...	...	10
Madhya Bharat ...	...	...	...	3

The most important means of irrigation in India are :—

(i) Canals ;
(ii) Wells ;and
(iii) Tanks.

The canals are the most important means of irrigation because of their cheapness and the ease and certainty of supply. Out of about 60 million acres, the total area irrigated in India, about 31 million acres are irrigated by canals (Government and private, both).

Fig. 34 on page 152 shows the importance of different sources of irrigation in India.

Canal Irrigation

The canals in India are of two classes :—

(a) Inundation canals ; and
(b) Perennial canals.

Inundation canals are taken out from rivers without building any kind of weir at their head to regulate the flow of the river and the canal. Whenever the river is in flood, water passes into these canals. As soon as the flood subsides and the river falls below the level of the canal head, these canals dry up. The greatest defect of these canals is that their water supply is very uncertain. They provide irrigation mostly during the rainy season when alone the rivers are mostly in flood. During the dry period when irrigation is needed most, these canals are useless. The largest number of inundation canals is in the Punjab. They have been taken out mostly from the Sutlej river, which has high floods during the rains. Owing to the uncertainty of water supply, most of the inundation canals are being converted into perennial canals with the help of the development of the large irrigation schemes.

The real importance in Indian irrigation is that of the Perennial canals, about 50,000 miles including the mileage of the distributaries, is so great that it can completely encircle the earth at the Equator twice. Such stupendous irrigation works have never been known in the history of the world before. And yet, they are not enough for the needs of our agriculture.

The Perennial canals irrigate only about one-tenth of the total cultivated area of India. The largest mileage as well as the largest acreage irrigated, is in U. P. where about one-third of the total cultivated area is irrigated by canals.

In the Punjab

There is no part of India which is so FAVOURABLY situated as regards its RIVERS, or so UNFAVOURABLY as regards its RAINFALL as the Punjab.

By far the greater portion of it has less than 25 inches of rainfall per year. Even this amount is often liable to failure. Until the introduction of irrigation, therefore, a large area was a waste. The only exceptions

were the river banks where agriculture was possible to some extent by means of inundation canals and wells.

The problem of irrigation in the Punjab was different from that in other provinces of India. In all other irrigation schemes the main object had been the improvement of the existing agriculture. In the Punjab, some tracts had to be colonised, simultaneously with the introduction of irrigation.

The Triple Canals system in the Punjab is one of the largest in India. Its main object is the irrigation of a tract of the Punjab lying between the Ravi and the Sutlej rivers, bounded on the south by the dry bed of the Beas, known as the Lower Bari Doab. This system transfers the waters from the Jhelum, where they were much greater than could be utilised in the water-shed between the Jhelum and the Chenab, for irrigating the water-shed between the Chenab and the Ravi and the Lower Bari Doab.

The transfer was effected by constructing a regulator at Mangla on the Jhelum. From Mangla the Upper Jhelum Canal carries the Jhelum water into the Chenab, discharging it into the latter above the headworks of the lower Chenab Canal at Khanki. The Lower Chenab Canal is thus fed with the Jhelum water, and the water of the Chenab so freed is taken from a new headworks situated at Merala, 36 miles above Khanki, into the Upper Chenab Canal. This canal runs southwards to the Ravi, which it crosses on the level at Balloki. Below Balloki it is known as the Lower Bari Doab Canal.

The chief reason for this scheme of canals was to conserve the Sutlej water for the further development and extension of irrigation on either side of the river.

The Triple Canals scheme has brought a further huge extent of wasteland under cultivation.

The Sutlej Valley scheme was, thus, the direct outcome of the great Triple Canals system.

There are, on either bank of the Sutlej long series of inundation canals, which drew their supplies from the river, whenever the river level was high.

The object of the Sutlej Valley Scheme was three-fold :—

1. By providing weirs and head regulators, to afford to the existing inundation canals a controlled supply of water from the beginning of April to the middle of October, thus freeing them from seasonal fluctuations. These canals are now converted from inundation to non-perennial canals, i.e., the supply is assured during summer as well, though they are closed during winter, when the volume in the river is low.

2. To extend irrigation to all the low-lying areas in the Sutlej Valley.

3. To give year-round irrigation to large tracts in the uplands on either side of the river.

A special feature of the canal system of the Punjab lies in the fact that all the rivers of the Punjab have been inter-connected by means of canals so that the water resources of all the rivers are pooled together to give the greatest service. All available supplies of water in the rivers are utilised to the full.

The scheme consists of four weirs, three on the Sutlej and one on the Panjnad (the name given to the Chenab below its junction with the Sutlej now in Pakistan) with twelve canals taking off from above them. The scheme really consists of four inter-connected canal systems.

The largest canal system of the Punjab is the Sutlej Valley Canal system which accounts, for about one-fourth of the canal-irrigated area of the Punjab, including Pakistan. Weirs have been constructed at four places on the river Sutlej and eleven canals have thus been taken out on both sides of the river. These dams are at Firozpur, Sulemanki, Islam and Panjnad. The most important crops irrigated in the Punjab are wheat and cotton. These two crops account for about half the total irrigated area. Rice comes next in importance.

The canals that are fully in the Punjab (India) are the upper Bari Doab canals, the Sutlej Valley canals on the left bank of the Sutlej, and the Sirhind canals starting from Rupar.

IN U. P.

The primary importance of the canals in U. P. is that they are essentially meant for periods of drought. Unlike the Punjab where, over large parts, no cultivation is possible without canals, in the U. P., in normal years, there is enough of rainfall and there are plenty of wells, so that it does not require canal irrigation. Canals when once built must be used, because irrigation from them is cheap and convenient. The largest canal system in U. P. is that of the two canals from the Ganga ; though, if taken singly, the Ganga canals yield the place of honour to the newly constructed Sarda canal. The Upper Ganga canal, as well as the Sarda canal have been taken out at a point where the rivers debouch from the mountains. Owing to the heavy rainfall a large number of rivers take their rise in the TERAI and join the Ganga in its middle course, more than making good the supply of water taken out at the canal head. It becomes possible, therefore, to take out a Lower canal to irrigate the middle section of the Valley. Such a thing is not possible in the Punjab where the rainfall is less and the TERAI is absent, leading to the absence of tributaries in the middle course of the rivers. The volume in the Punjab rivers dwindles as they flow away from the mountains, while in the case of the U. P. rivers it increases, because the rivers flow through a wet country. This enables a 'lower canal' to be taken out. The Lower Ganga canal already exists, while a 'Lower Sarda Canal' is in the project, as people become used to canal irrigation. There are two canals from the Jumna also. A few minor canals also exist in south U. P. ; like the Ken, Ghaghar, and the Betwa canals.

Canal irrigation is less important than well irrigation in U. P. The area irrigated by canals here is about 3 million acres. This is only about one-twelfth of the total

AREA SOWN, and only one-third of the total area irrigated. The canal-irrigated area in U. P., however, fluctuates from year to year according to the condition of rainfall. In those years in which the rainfall is scanty, canal-irrigated area is very large. In other years in which the rainfall is good, this area diminishes. Wheat, barley, sugarcane and cotton are the important irrigated crops.

Like the Punjab, a serious problem has arisen in the canal-irrigated areas of U. P., and that is the problem of alkaline soils which are believed to be due to overirrigation; so natural in a country where scarcity of water leads to famine.

The high rainfall makes it necessary to construct and maintain drainage works in this province to safeguard the canals from damage. The drainage works in this province have a longer mileage than the canals themselves.

An important service rendered by the canals in U. P. is that they help in reducing the intensity of floods in the Ganga and the Jumna, by opening up all their branches and distributaries.

IN MADRAS

The Madras Presidency is another province where canal irrigation is important. Here most of the canals are in the deltas on the east coast where suitable land for canal irrigation lies. These deltas are not wet like the Ganga delta where the tremendous discharge of the Ganga and the Brahmaputra rivers keeps the soil too wet to need irrigation. The greater rainfall of the Ganga delta keeps the depressions filled to serve the needs of irrigation, if there is occasion for it at all.

In Madras also the canals are more important as a source of irrigation than either tanks or wells. The canals irrigate about one-third of the total irrigated area here. The crops that are important under irrigation are rice, jowar, bajra, and cotton.

Most of the rainfall on the east coast comes during November and December when the important summer crops have been reaped. To help these summer crops to grow during the period when the rainfall is low, canal irrigation is absolutely necessary. At this period the tanks and wells become less effective owing to the smaller rainfall. The canals, on the other hand, drawing their water from rivers which have their sources in regions which have most of their rainfall during summer, are able to supply the much-needed water for crops.

The Delta canals of the east coast are used to a considerable extent for navigation as well. The deltas are not well provided with railways. This naturally adds to the importance of canals as means of transport in the region.

The canal irrigation in other parts of India is not much important, either because the canals are small, as in Bombay; or they are meant for some other purpose and irrigation is only a secondary object, as in Bengal and Bihar. The Bengal canals are primarily for supplying clean drinking water and for draining the low-lying parts, as well as for navigation. The followlng table shows the details of the canals in Bengal :—

BENGAL CANALS

Canal	Length Miles	Irrigation Acres	Year Made
Mednapur	324	125,000	1888
Damodar	259	180,000	1932
Eden	45	25,000	1938
Kulai Khal	2	600	—

The Mednapur canal is navigable for about 24 miles where the depth of water available is from 4 to 5 feet.

The canals of the area adjoining the Western Ghats are characterised by high dams across deep mountain valleys.

Thus the valleys are converted into reservoirs from which canals are taken out.. An important example of such a dam is the Bhandardara Dam in Bombay. It is one of the highest dams in the world. In the district of Ahmadnagar, at Bhandardara on the Pravara river, a dam 270 feet high has been built to collect the high rainfall of the Western Ghats. The canals taken out from here are about 85 miles long.

Another example, needing much engineering skill, is that of the Periyar river whose course has been diverted from the west to the east to utilise its waters for irrigation. The valley has been closed towards the west by means of a dam 175 feet high and a lake has thus been formed. The waters of this lake are let into a canal 150 miles long through a tunnel 1¾ mile long through the mountains. The main feature of the Periyar system is the diversion of the Periyar river from the Arabian Sea into the Bay of Bengal. This river has its source in the Palni Hills in Travancore whence it flowed westward to the Arabian Sea through a forested and an uninhabited country. To the east of the watershed is the Madura district of Madras which was subjected to frequent famines. The Vaigai river is the only drainage of importance in Madura and on its scanty and unreliable water supply practically the whole irrigation of this district depended.

The principal thing in the scheme is the dam. This is situated in a V-shaped gorge in the Hills. A lake is thus formed. From the most northerly arm of this lake the water is led for about a mile through a deep open cutting to the mouth of a tunnel made across the watershed. On the other side of the watershed a short open cut conveys the water into a natural ravine, by which it finds its way into the Vaigai. It is through the Vaigai river, therefore, that the waters of the Periyar are utilised for irrigation.

Irrigation facilities have resulted from some of the works built specially for generating hydro-electricity. Among such works the Mettur Dam in Madras is of outstanding importance.

The Mettur Dam is built across the Cauvery river at a point 240 miles from its source. The Dam has been built with a double purpose: (i) to generate hydro-electricity and (ii) to irrigate about a million acres of rice fields in the Cauvery delta, 125 miles away from the dam. Irrigation is done with the help of about 70 miles of main canals together with about 600 miles of distributaries.

Some of the important canals and the area irrigated by them in 1948-49 are given below :—

Canal	Main Mileage	Distributary Mileage	Area Irrigated Lakh acres
Upper Ganga ...	569	3429	15
Lower Ganga ...	640	3321	10
Eastern Jumna ...	129	836	4
Agra Canal ...	100	911	2½
Cauvery Delta canals ...	943	3798	10
Godavari Delta canals ...	510	1925	12
Krishna Delta canals ...	425	2374	11
Periyar canals ...	152	118	2

Well Irrigation

The well may be said to be the indigenous form of irrigation in India. It is very well suited to the poor Indian farmer, because it is cheap to build, requires no elaborate machinery to work it, and does not need any specialised engineering skill to build it or to work it. It can be dug at the very door of the farmer, if necessary. Well digging needs no elaborate survey of levels as is

necessary for canal construction. A simple KACHCHA well costs as little as 10 rupees in most of the districts, and is, therefore, within the means of the poorest of farmers. A canal, on the other hand, costs lakhs of rupees and can be undertaken, in a poor country like India, only by the Government.

Apart from this economic consideration, well irrigation is suited to a large part of India on geographical consideration also. Over a large part of the country the soil consists of a sandy loam underlain here and there by isolated beds of clay which appear floating in a sea of sand that is highly saturated with moisture that percolates through the soil. These clay beds act as reservoirs which when tapped by digging, supply large quantities of water which can be easily lifted to the surface. The geological formation of India is too simple to provide opportunities for 'artesian wells' where the pressure of water underneath is so great that it comes to the surface automatically. In some localities where the above mentioned clay beds are thick enough, much larger supplies become available in the well by boring a hole (tube well) through the clay than are possible in the ordinary 'spring well.' These 'tube wells' are expensive to build, and, to be effective, need machine power to lift large quantities of water.

The factors governing the supply of water to the underground which feeds the wells are :—

1. Local rainfall;

2. Slow seepage from the land lying at the base of the mountains, or Terai, where the rainfall is higher;

3. Seepage from canals and canal-irrigated lands and seepage from other water bodies.

Well irrigation in India is limited by :—

(a) Water level being too low in certain areas. This is particularly found in the neighbourhood of rivers. It appears that water level sinks deep near the river banks to rise in the river bed. No generalisations are possible

with regard to the water table in India as the subject has not yet been studied. Those districts in which the rainfall is very heavy usually have a high water table and the water is very near the surface. In other districts, where the rainfall is limited water table is low and the wells have to be very deep.

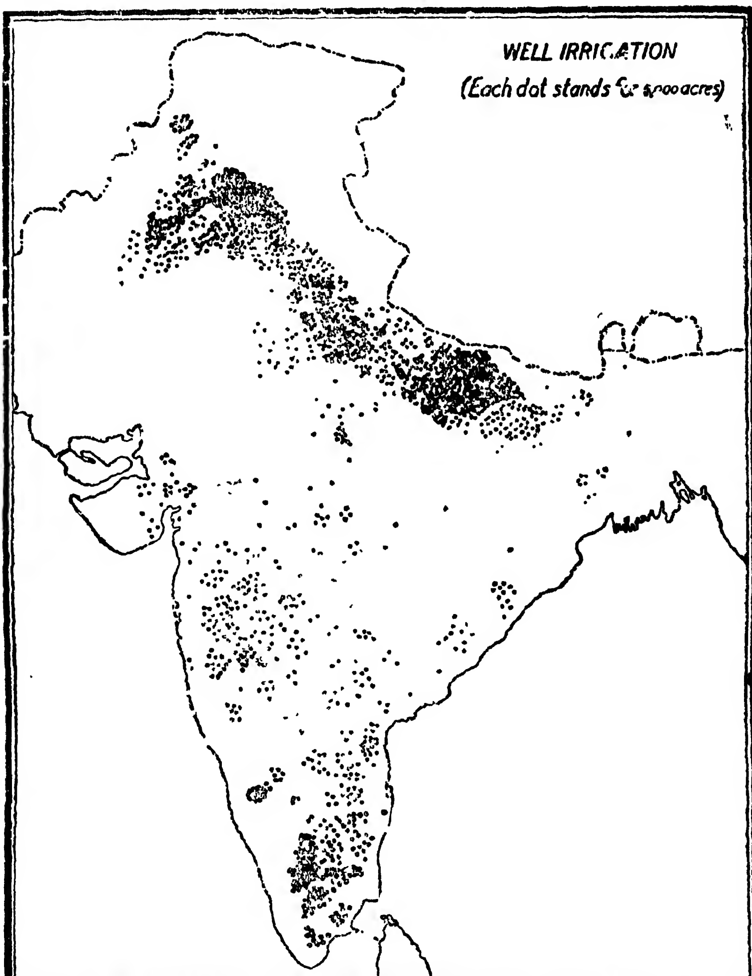

Fig. 35.

(b) The second limitation is the brackishness of the well water. Brackish water is useless for irrigation as it destroys the crop. No data are available in this respect also; but it appears that brackish water may appear anywhere, even in a locality where other wells are sweet. The districts where water is usually brackish have very little well irrigation.

(c) The third limitation is that a large number of ordinary wells dry up during periods of drought when their water is needed most. They also mostly dry up after a few hours excessive lifting of water, and are, therefore, unable to irrigate large areas.

An analysis of the figures of well irrigation shows that the well irrigation is of considerable importance in

(i) that part of the Gangetic Valley which is in close proximiiy to the north-eastern and eastern extension of the Deccan tableland. This includes the eastern part of U. P., Southern Bihar, and Western Bengal.

(ii) Regions of the Black Cotton Soil, specially where it is deep.

(iii) The submontane areas on the eastern side of the Western Ghats.

This includes southern districts of Bombay and of Madras especially Coimbatore, Madura and Ramnad, etc.

(iv) The submontane districts of the Punjab.

The regions immediately in the neighbourhood of the Himalayas, the Assam and Arakan Hills, and to the west of Western Ghats are particularly deficient in well irrigation.

Well irrigation accounts for about one-fourth of the total irrigated area in India. The most important provinces in order of importance are U. P., the Punjab and Madras. Even in canal-commanded areas well irrigation is practised in elevated parts where the canal water cannot reach.

Recently U. P. Government have bored a few tube wells to extend irrigation in areas where canal water could not reach. These tube wells are worked by electricity generated on the Ganga canals. The drawing of large quantities of water from the tube wells raised the question whether the water table of the province will be lowered and thereby dry up a number of the ordinary spring wells. The question has been enquired into by Mr. Auden whose report is summarised below* :—

The areas in which tube well pumping is contained should not be considered as isolated units independent of the neighbouring areas; they should be regarded as part of the Gangetic alluvial system, which, east of the submerged extension of the Aravallis from Delhi towards Dehra Dun, occurs in a single basin almost certainly without underground barriers of any magnitude. Continuity of the alluvium in this basin permits the greater rainfall supply of the Terai belt being operative as a means of replenishment in the area to the south. The boring of the tube wells has proved that sand predominates over clay in the sub-soil of this basin. The water in these sands occurs as a continuous reservoir, which must be connected with the starta below the Terai where the rainfall is greater. There is; therefore, a considerable excess of rainfall over the water removed by pumping.

In the Deccan, water bearing strata is seldom found except in faults and fissures in the rock. The exact location of an underground stream is necessary for any successful boring. This is where the help of a geologist is required and a water diviner may also help.

Twenty-one tube wells with an aggregate discharge of about 400,000 gallons per hour have been made for the Ahmedabad mills.

Sub-artesian tube wells are those in which water requires pumping. Sub-artesian water is generally obtain-

*Report to the U. P. Government on Tube Wells, 1936.

able between 250 feet below surface, while for artesian flow, the boring requires to be carried down to between 600 to 1,000 feet below the surface.

A fine example of an artesian bore may be seen at Chhaloda near Ahmedabad. Here a boring was put down 842 feet deep and yields a water supply of 650,000 gal. per day. This water comes up the tube under great pressure and has been flowing day and night for the last several years. The travellers from Ahmedabad pass through miles of dry sandy soil and on approaching Chhaloda appear to have come upon an oasis in the desert. The water has formed lakes round the village. The actual cost of the water comes only to 1 pie per 1,000 gallons.

A scheme to provide more artesian tube wells at some of the villages in Gujarat is under the consideration of the Government of Bombay.

Tank Irrigation

About one-tenth of the total irrigated area of India is accounted for by the tanks, more than half of it being in one province, Madras. The only area important for tank irrigation outside the Deccan tableland is in North Bihar. The undulating topography of the Peninsular region, and the depression caused by the old beds of rivers in North Bihar are converted into tanks by deposits of rain water. Like the well irrigation, the tank irrigation also suffers from uncertainty owing to the precariousness of rainfall over most of the areas where tanks are common.

Extension of Irrigation

The importance of irrigation is not the same for all crops grown in India. The crops which have to be in the field during the dry period of the year are naturally the most irrigated crops in India. But owing to the considerable labour and expenses involved in irrigation, only the most paying crops are irrigated first. Thus, sugarcane, cotton and wheat are generally the most important for irrigation. Less cotton is, however, irrigated than sugarcane, chiefly because it is grown mostly in the

Black Cotton Soil. The soil is difficult to irrigate owing to cracks in it and owing to fewer facilities for irrigation being present in that area. Important areas of irrigated cotton occur generally in the Punjab and in Madras. The following diagram shows the irrigated part of the most important crops of India.

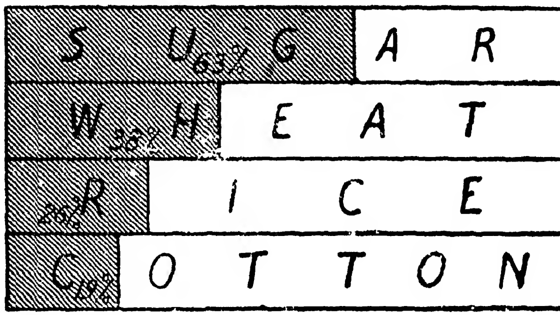

Fig. 36. Irrigated (shaded) part of certain crops.

The above diagram clearly shows the need for further irrigation facilities in India. If these facilities were available, about two-third of the area under wheat could benefit. This would increase the yield and, therefore, the total output of wheat in India.

The crying need for extending the irrigation facilities in India is further shown by the following table which gives the proportion of the total cultivated area that receives irrigation in certain areas :—

PROPORTION OF IRRIGATED TO NET CULTIVATED AREA

State	%Irrigated to cultivated
Assam	19
Bihar	27
Bombay	6
East Punjab	40
Madras	33
Orissa	25
U. P.	31
West Bengal	21
INDIA	26

The above table shows that in an important agricultural area like the U. P., irrigation plays only a minor part. Even for the country as a whole the proportion of irrigated area is only 26%.

It is clear, therefore, that extension of irrigation facilities is the crying need of Indian agriculture.

QUESTIONS

1. Why is irrigation so necessary for Indian agriculture ?

2. How far do geographical factors help the practice of irrigation in India ?

3. Why are canals a more popular source of irrigation than wells or tanks in India ?

4. Briefly describe the important canal systems of (*a*) the Punjab and (*b*) U.P. emphasising the nature of the country they serve.

5. What factors, geographical and economic, favour well irrigation in India ?

6. Will the power-worked tube wells in U. P. affect adversely the water table ?

7. Why is it more difficult to dig wells in the Deccan than in the Ganga Valley ?

8. Write a short note on :—

   (*a*) Mettur Dam.

   (*b*) Bhandardara Dam.

   (*c*) Irrigation in the Punjab.

CHAPTER VII

INDUSTRIAL FUELS

Coal is the outstanding industrial fuel of the modern world. Without it the present 'Machine Age' will come down crashing. In the modern world the economic power of countries is measured by the amount of coal they control. It is around coal that most of the industries of the world flock. Nature has, however, not been very generous to India in the matter of coal. Most of the coal of the world is found in the Cool Temperate Zone of the Northern Hemisphere, and not in the Tropics of which India is a part.

India stands eighth among the coal producers in the world. In 1949 her total production amounted to about 31 million tons which was only one-fifteenth of the British, and one-twentieth of the U. S. A.'s coal production. Not only in quantity but in quality also, India is behind the important coal producers. The best Indian coals are inferior to the average British coals. The coking coals of India appear to be characteristically high in phosphorous and moderately high in ash. The moisture present in Indian coals is also considerable.

The coal-fields of India can be broadly divided as follows :—

1. Gondwana coal-fields :—

(a) Damodar Valley fields :

(i) Jharia,
(ii) Raniganj,
(iii) Bokaro,
(iv) Girridih,
(v) Karanpura (North and South).

(b) Mahanadi Valley fields. No importance.

(c) Son Valley fields. No importance.

(d) Godavari Valley fields :
Singareni.

2. Tertiary coal-fields :
Makum in Assam.

Practically 97 per cent of the coal supplies of India are derived from the Gondwana rocks which are found

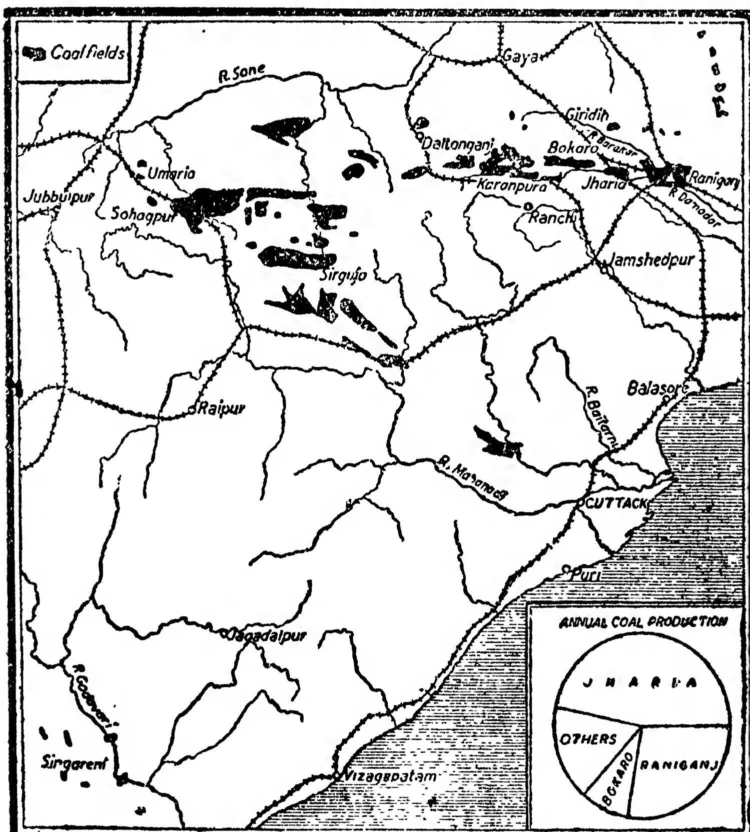

Fig. 37. The main coal-fields of India

in the Deccan tableland. These rocks are very old and are composed chiefly of sandstones and shales which appear to have been entirely deposited in fresh water, and probably by rivers. The only section of the Gond-

wana system which is important from the point of view of coal production is that known as the 'DAMUDA SERIES' from its development in the valley of the river Damodar. In the Raniganj and Jharia fields these rocks can be subdivided into three stages or divisions, of which the top and bottom divisions, known respectively as 'RANIGANJ' and 'BARAKAR' rocks, alone contain coal seams. The rocks lying between these two divisions are IRONSTONE shales which possess no coal. The most important coal seams in the Raniganj coal-fields are found in the RANIGANJ 'rocks' while the most important seams in Jharia coal-fields occur in 'BARAKAR rocks'; that is, good coal occurs in upper rocks in Raniganj coal-fields, and in lower rocks in Jharia.

The fields which have been worked to any extent in the Gondwana region include :—

(1) the Raniganj and Jharia fields in the Damodar Valley ;

(2) the Giridih field occurring as a small isolated patch to the north of the Damodar Valley ;

(3) the Daltonganj field, further west in the Palamau district ;

(4) the Singareni, Ballarpur and Warora fields in the Godavari Valley ; and

(5) the Mohpani and Pench Valley fields adjoining the Satpuras.

The north-west ends of the Godavari and Mahanadi valley coal-fields have been buried under the great sheets of Deccan trap, and therefore, no one knows how much coal lies hidden under this cover. Similarly the eastern ends of the Jharia and Raniganj fields are buried under the Ganges alluvium making it impossible to determine the quantity of coal in India.

Outside the Peninsula and the Gondwana rocks some coal occurs in Assam. This coal is newer in age than the Gondwana coal. It is known as the 'Tertiary' coal. The thick seams of the Lakhimpur district in the Dihing

River Valley in Assam are the most important in tertiary coal in India.

The JHARIA coal-field is the most important Indian coal-field, not only because it produces about one-half of the total coal produced in India, but because it produces the best Indian coal. It is the only coal-field in India which has sufficient quantities of coking coal. Its area is only about 150 sq. miles. The 'BARAKARS', or the lower layers of the Gondwana rocks, are by far the most important to the coal miner. No attempts were made to work the thinner and poorer seams of the upper layers, the 'RANIGANJ' until the boom in the coal prices in 1906-08 led to the opening up of every tolerable seam of coal within range of the railways. There are 18 seams in the lower (Barakar) rocks totalling about 200 feet of coal, numbered from the outer fringe running like a crescent. Except in the south-east corner of these seams, which is considerably faulted, there is little disturbance in the coal seams. By far the larger proportion of hard coke made in India is made from Jharia coal, and the recovery of coke averages about 75% of the coal used.

The coals of Raniganj, Jharia and Giridih coalfields compare in quality as follows :—

COAL FROM THE BEST SEAMS

Coal-field Seam	Moisture	Volatile matter	Fixed carbon	Ash
	%	%	%	%
Raniganj, Ghusik	7·5	34 8	52·6	12·6
Raniganj, Dishergarh	2·5	33·2	54·2	9·8
Jharia, No. 18	1·8	28·8	59·3	11·9
Jharia, Nos. 5-6	0·6	14·1	66·2	19·8
Giridih, Karharbari	0·9	22·5	66·0	10·6

A large quantity of the coal in Jharia field, as also in Raniganj and Bokaro field, has been burnt out by the Deccan lava. The damage caused is particularly great in

the 14th and 15th seams. The evidence of this burning is to be found in the large quantity of 'JHANWAN'.

The importance of the Jharia coal-field lies not only in the fact that it contains the best coal in India, but also in the fact that it lies on the margin to the Gangetic plain with a network of railways, and that it lies near Jamshedpur, Kulti, Asansol, and Calcutta which are the largest markets for coal in India. Jharia is connected by the E. I. R. with Calcutta which is about 170 miles from it. It is connected with Jamshedpur by the B. N. R. The E. I. R. thus supplies its coal to the Indo-Gangetic plains, while the B. N. R. carries it to the Indian peninsula.

In spite of the good quality of coal in Jharia, no manufacturing industries of any importance have been attracted to it. The chief reason of this is the fact that there are no valuable raw materials near it. The immediate neighbourhood of Jharia consists of almost barren and rocky land where it is difficult to obtain large quantities of suitable water. Even the coal mining industry gets its water with difficulty. Unlike the best coal-fields of Europe or America, Jharia is, therefore, unable to attract any industry to itself.

The RANIGANJ field produces about one-third of the total coal of India. It covers an area of about 500 sq. miles, most of it in the district of Burdwan, but stretching also across the boundaries into Bankura, Manbhum and the Santhal Parganas. It occupies a larger area than the Jharia coal-field. The seams dip generally to the south and south-east throughout the field. As the beds dipping to the south-east are covered by the alluvium of the Damodar Valley, the distance to which the coal-bearing rocks extend in this direction towards Burdwan and Calcutta is unknown. There are six workable seams in the upper (RANIGANJ) rocks totalling roughly 50 feet of coal. The Dishergarh seam of Raniganj has the most valuable steam coal in India which is in great demand for railways and ships.

Besides the above two coal-fields of great importance, India has a few coal-fields of minor importance. The great

belt of Gondwana rocks, near the north-west end of which Warora is situated, stretches down the Godavari Valley as far as Rajahmundry, and at one or two places the equivalents of the coal-bearing Damuda series of Bengal are found cropping up from below the upper Gondwana rocks. One of these occurrences, near Yellandu in Hyderabad forms the coal-field named Singareni. The principal seam of coal is about 5 to 6 feet thick.

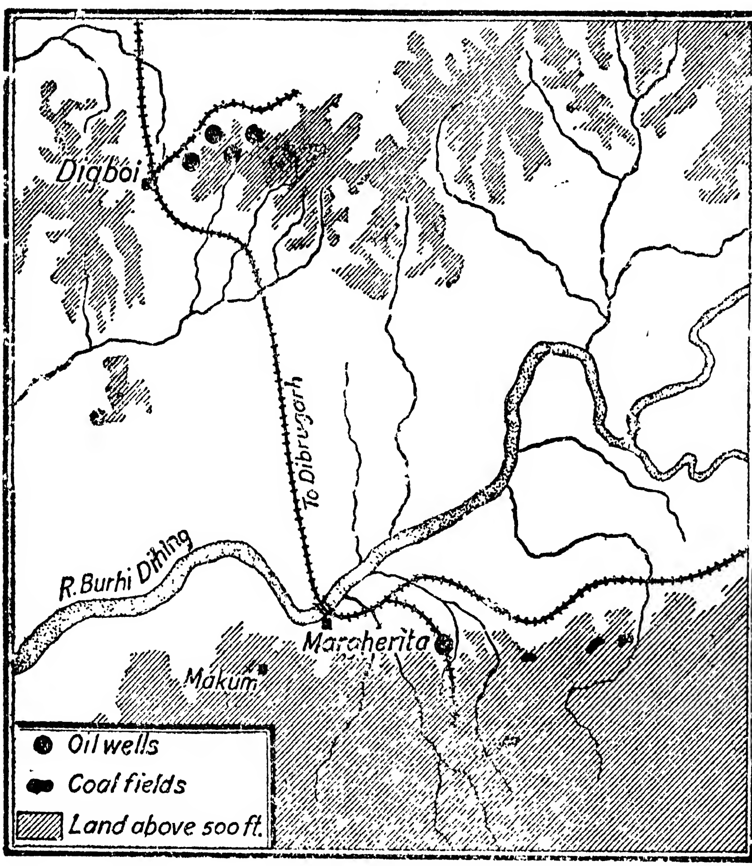

Fig. 38. Occurrence of coal and oil in Assam.

The newer or Tertiary coals of Assam differ from the Gondwana coals in containing a larger portion of moisture

and volatile matter. They also generally have a lower ash content.

The Tertiary coals have a high sulphur content which makes them useless for coking.

The most important among the Tertiary coals are the Assam coals near Makum. The collieries are connected by a metre gauge railway with Dibrugarh on the Brahmaputra river, which being navigable forms both a market (use on steam boats) and a means of transport for coal. The coal-bearing rocks stretch over long distances both to the north-east and the south-west. The most valuable seams occur between the Tirap and the Namdang streams where, for a distance of about five miles, the seams vary from 15 to 75 feet in thickness. Near Margherita, the average thickness of the thickest seam now being worked is about 50 feet. In the Namdang section it increases to as much as 80 feet. The outcrops in many places are several hnndred feet above the plains on mountain slopes, and facilities exist for working the coal by adit levels as in Wales. Coal can be dug in horizontal tunnels, not in deep vertical pits.

Coal of good quality also occurs in the Namchick Valley, a tributary on the left bank of the Dihing River, above Margherita.

Coal Reserves

It is estimated that the total reserves of all kinds of coal in India amount to about 54,000 million tons. Of this only about 5 p. c. is supposed to be suitable for coking.* The three most important fields in respect of coal reserves are Raniganj (21,000 million tons), Jharia

*The 'coke' is made from coal by first powdering it and then burning it, until the impurities in coal are removed. This burnt coal is then cooled by pouring water over it. Lumps then form. We, thus, have the coke. The capacity to form into lumps is the chief feature of 'coking coals'. Good quality coal produces 'hard coke' while the inferior quality coals produce 'soft coke.' The former alone can be used in the metal industries.

(20,000 million tons) and north Karanpura (8,900 million tons).*

Dr. Fox and Dr. Fermor of the Geological Survey of India estimated for the whole country the total quantity of coking coal suitable for the manufacture of metallurgical coke at the end of 1932 to be as follows:—

At depths of	0—1,000 feet	=1,118	million tons.
At depths of	1,000—2,000 feet	= 576	,, ,,
		1,604	

No doubt, in the opinion of Dr. Fermor, small additional quantities of good coking coal will be discovered in the future, possibly for example, in west Bokaro; but the probable amounts are not likely to alter the real position. In addition, with technical research strongly coking coals, not at present regarded as coking coals, such as the semi-coking coals of Karanpura may also become available. But these are after all, only possibilities.

Apart from Giridih, which is only a small field, the best coking coals in India occur in the Bhagaband and Jialgara stages of the Jharia field, 737 million tons of this is in depths upto 1,000 feet from surface and 163 million tons between 1,000 and 2,000 feet. With the present

*The National Planning Committee Report (Power and Steel), 1947 estimated the Coal Reserves of India as follows:—

Total Coal Reserves of India

		M. Tons,
Darjeeling & Eastern Himalayas	...	100
Giridih-Deoghar	...	250
Raniganj-Jharia	...	25,650
Sone Valley	...	10,000
Chhattisgarh & Mahanadi	...	5,000
Satpura Region	...	1,000
Wardha Valley	...	18,000
Total	...	60,000

methods of working not more than 50 p. c. of this coal will be won, and the remainder will be lost due to collapses, fires and floods. The total annual extraction from Jharia is about 10¼ million tons; practically all of which comes from the Bhagaband and Jialgara stages in which all the coking coal is concentrated. The life of the coking coals of the Jharia field, down to 1,000 feet from the surface is taken by Dr. Fermor to be 41 years under the present circumstances. He expects this life to be reduced to 33 years under normal development of mining in India.* If the methods of mining are improved and sand packing is undertaken to check fires and subsidence, this life may be increased to 100 years.

Even in spite of this shortage of coking coals on which the development of the iron and steel industry in India is dependent, there is no check against the coking coals being used for purposes other than the one for which they are best suited. In 1932, only 15 p. c. of the coking coal mined was actually used for the manufacture of hard coke: the rest being used for railways and other purposes.

*Dr. N. N. Chatterji of the Geological Survey of India, however, estimates the life of the Indian Coal reserves at the rate of present mining as following :—

With Sandstowing	Without Sandstowing
Coking Coal** 75 years ...	50 years.
Non-Coking Coal 200 years ...	135 ,,
Inferior Coals 400 years ...	268 ,,

**If the coking coals are used only for the metallurgical industry, the reserves can last for 225 years at the present rate of consumption of this type of coal.

The sources of the supply of coal in India in 1948 were as follows :—

	Lakh Tons
Bihar	163
West Bengal	81
M. P.	30
Hyderabad	10½
Rewa	7
Orisa	4
Assam	3½
Bikaner	¾

Coal Conservation

It is clear from the above that there is a great need for conservation of Indian coal. This need is to be doubly emphasised in view of the post-war schemes of industrial development in India. The best method of conserving Indian coal is to reserve the use of the best quality coals only for metallurgical industry. These coals should not be used for generating steam as in transport or industries. For steam purposes, for example, inferior coals from Raniganj or other coalfields should alone be used. The most inferior coals should be used either in the form of liquid fuels or they should be used for generating electricity which can then be used for industrial purposes.

Conservation also implies a better system of mining. Miners should take out all coal that can be practicable. The present practice of taking out only the best quality coals and leaving the rest in the mines in such a way that it can never be recovered must be given up. It is obvious that this can be done only when it is realised that coal is a national asset on which the future of India depends, and that it is an asset which can never be reproduced. Once lost, it is lost for ever. This characteristic and the importance of coal make it necessary that the exploitation of Indian coal should not be left entirely in the hands of the private capitalist.

Conservation of Indian coal also implies that every ounce of energy that can be obtained from it must be obtained, or every bit of by-product that it can yield must be recovered from it in the interest of the future of the country. The present wasteful method of soft-coke making must, therefore, be changed. Dr. Chatterji,* for example, calculates the loss involved in the production of Soft Coke in India (about 2 million tons yearly) as follows :

2 million tons of Soft Coke result in the loss of :—
0·75 million gallons of motor spirit
1·5 " " " light oils
3·0 " " " lubricating oils
0·75 " " " Carbolic acid and Creosote oil
10,500 tons of ammonia sulphate
15,000 " " residual pitch
7·5 billion cubic feet of rich gas from which 50 million horse power can be developed

COAL TRADE

India has a very limited home market for coal. Ceylon and the Far Eastern countries are the only important markets outside India. Our export trade in coal is, therefore, insignificant. The five-yearly average, from 1935-36 to 1939-40, came to about 1,164,000 tons. This was only about 4 % of our total output of coal then. Even this figure is, however, better than the 5 yearly average of 1929-30 to 1933-34 which was only 492,000 tons. In recent years the exports of Indian coal have been as follows :—

	1946-47	1947-48	1948-49	1949-50
Tons (Lakh)	5·4	4·8	11	12
Value (crore Rs.)		1½	3¾	...

*N. N. Chatterji: Proceedings of Indian Science Congress, 1945.

In 1949-50 our exports were distributed as follows :—

	Lakh Tons	Value
Pakistan	5	1 crore Rs.
Ceylon	2½	...
Burma	1	...
Singapur	½	...
Hongkong	1	

The high cost of land transport which our coal must bear, if it is to be exported; and the general industrial backwardness of our neighbouring countries, which limits the demand for our coal, are some of the factors in our backward foreign trade in coal.

The largest market for our coal is the home market. This market is, however, negligible. India is a hot country where the demand for domestic heating, common in Europe or America, is not important. The backward industrial development of India is also a factor in this smallness of the market for coal in India. The result is that the per-head consumption of coal in India in normal years is not even one-thirtieth of that even in such a country as Canada. The following table gives the per-head consumption of coal before the war.

Great Britain	...	...	3·9 tons
Belgium ...	...	...	3.9 „
U. S. A. ...	...	...	3·3 „
Canada ...	...	...	2·2 „
Germany ...	...	...	2·0 „
India ...	...	...	0·07 ton

About 40% of the coal produced is consumed by

manufacturing industries and about 32% by railways.† The backward state of our industries limits the production of our coal, because more coal will be produced if there is a demand for it. A profitable source of the demand is the domestic use of soft coke for cooking purposes. It has been noted that practically nine-tenth of our coal is inferior in quality from which only soft coke can be manufactured. This soft coke can be used best in our homes as domestic fuel, releasing the cow-dung which is a valuable MANURE rather than fuel. We have also seen that the wood fuel is limited in supplies in India. It will, therefore, be best for the coal trade which can then give more employment; for our railways which will get more business; and for our agriculture which can get more cow-dung for manure, if we used more and more soft coke as fuel in the home.

Owing to the efforts of the Indian Soft Coke Committee about 9 lakh tons of soft coke were supplied to the market in 1939 from the Bengal and Bihar coalfields. In the opinion of this committee if the railways charge lower rates on soft coke it can easily compete with wood and charcoal in cheapness.

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† In 1938 the consumption of Indian coal in India was as follows :—

		Thousand Tons
Railways		8,183
Industries :		
Iron and Steel	5,905	
Cotton	1,979	
Bricks	1,509	
Jute	773	
Paper	233	
Tea	186	
		10,585
Consumption at Collieries ...		1,445
Other Industrial Works ...		5,762
Others		1,025
Total ...		27,000

The inferior quality coal is not suited to the manufacture of by-products. It is only from the coal from which hard coke, suitable for smelting, is manufactured that some by-products are obtained at present. These by-products are coal-tar and ammonium sulphate. The former has a large market in Calcutta and the latter is mostly exported to Java.

Unlike the coal in U. S. A. and Europe, our coal occurs in regions which are not endowed with facilities of water transport which is the cheapest method of transporting coal. There are no canals or navigable rivers in the chief coal-producing region of India. The scarcity of even drinking water is a feature of these regions which is a source of great inconvenience to the people working in the mines.

Both in Raniganj and in Jharia underground fires are causing a great damage to the coal and are a cause of serious colliery accidents, apart from reducing our resources in coal. Sand-stowing or filling the affected part of the mine with sand, is the best method recommended for putting out these fires. Owing to the expense involved, however, our mine-owners are seldom willing to follow this practice. They generally seal the portion of the mine which is affected by underground fire and stop work in that section.

In November, 1939, however, the Coal Mines Stowing Board was constituted by the Government for the purpose of putting out these underground fires. The activities of the board are financed from the proceeds of an excise duty levied on coal raised from mines in India, except those in Assam.

Modern war is a war of sources and for it coal is the most important of these resources, for it provides power for (a) factories, and (b) transportation, (Rail and Ship).

As coal is by far the most important and the cheapest fuel, it goes without saying, therefore, that a modern war cannot be fought without coal. Coal is needed for manufacturing armaments and munitions, battleships, tanks,

guns, machine-guns, aeroplanes, bombs, bullets, shells, which must be manufactured for the modern war. All this cannot be done without coal.

For these manufactures raw materials and workers from long or short distances must be transported. Finished products must then be transported from the factory to the field where they will be needed by the soldiers. Most of this transport, depends on coal.

Production and transport are, in short, the two essentials of modern warfare. Both require coal.

India occupied a notable position in the last war. It is the only important country which was most easily accessible to the Allies from the African as well as the Burma Front. The Axis proximity to the Mediterranean made the Suez Canal the most important supply route to the African Front. India is situated on the direct route to the Suez and hence her importance as a supply base for the African Front was great. For the Burma Front India was the nearest and the most suitable base of supply.

This placed on India the burden of supplying two important fronts in the war. Part of the supply which her backward industrial state allowed, was produced within the country ; the other part was transported here. Thus, to solve the problem of supply in war coal becomes a necessary factor.

It is obvious that the demand for coal was increased owing to the stress of war. The increased demand meant better prices and, therefore, better profits for the coal mining industry in India.

The significance of this cannot be appreciated fully, until it is realised that during peace times the Indian coal mining industry was running at a loss. It was not until Japan invaded China that the output of coal in India increased, owing to the demand for coal from China. The Chinese coal mines had been occupied and closed by Japan. The nearest source of coal for China was India, and, therefore, a large export trade in coal from India resulted. Soon after, the second World War was started in Europe

in 1939, the Indian coal-mining industry received the impetus that naturally results from a war.

The output of coal increased considerably, setting up a new record. The figures of production for the recent years are as follows :—

1935	23	million tons
1936	23	,,
1937	25	,,
1938	28·3	,,
1939	27·7	,,
1940	29	,,
1948	30	,,
1949	31	,,

This great increase in Indian output was partly the result of the geographical position of Indian coal. It will be noticed that India is the only important coal producer among the countries bordering the Indian Ocean. Between the African Front and the Burma Front, India was the only country that could supply large quantities of coal. Indian coal was needed not only in India, but also in the far-off countries that never bought coal from us before.

The increased output of coal shown by the above figures does not, however, give the full picture of the effect of the war on coal mining in India. The output would be much bigger if certain impediments had not been there.

It is known that ordinarily the output of the coal mines in India is limited by what the railways can transport. More the railway wagons available, the greater is the amount of coal brought to the pitmouth. In short, the problem of wagon supply was the crux. During the last war much attention was given to this question. There was a coal wagon supply committee, which dealt with the priority of various coal mines for getting railway wagons to transport their coal. The effect of the last war had been that there were more than 12 lakh wagons engaged in the transport of coal. This figure was the largest used in any single trade. For example, it was seven times more than the number of wagons used for the transport of

cotton ; about six times of those used in the transport of oilseeds ; and two times that used in grain and pulses. In spite of this huge number of wagons, coal industry needed more. Almost the whole of this number of wagons transported coal for the essential services only ; i.e., for railways, shipments, on government account and for factories engaged in war work.

The fact that the coastal trade in coal had practically ceased placed added burden on the railways for transporting coal to the port towns to which it used to go formerly by sea.

In India the shortage of coal wagons was particularly marked during the winter months from December to March when the strain on the railways is greater for carrying the agricultural produce like cotton, oilseeds and sugar. Cheaper rates were allowed for the carriage of coal during the slack period from April to November to induce the coal consumers to build their stocks of coal. Unfortunately, however, the rains interfere with the raising of coal during this period and the cheaper rates did not materially affect the question of wagon supply. Railways were forced to carry more coal during the period of rush, thereby aggravating the problem of wagon supply. Owing to the shortage of wagons, therefore, the coal-mining industry of India could not cater for the needs of the non-essential consumers and the general public.

This last class of consumers took generally the second class coal produced in India. Second class coal was produced largely by the small mines, which had practically closed down on account of the wagon-shortage due to the stress of war requirement.

We can conclude by saying that the immediate effect of the last war on the coal-mining industry in India had been to maintain the steady progress of the industry which the Japanese invasion on China had already initiated in 1937. A far-reaching effect of the war must, however, be sought through the general expan-

sion of industrial activity in India. Greater industrial activity in India means greater market for coal, which means greater prosperity for the industry.

Coal mining is the most important branch of mining industry in India, as will be seen from the number of persons employed in mining in 1948 given in the following table :—

	Thousands
Coal	348
Salt	89
Mica	32
Gold	24
Manganese	20
Iron-ore	9
Petroleum	4
Others	13
Total	539

PETROLEUM

India's position is even worse in petroleum resources than in coal. Petroleum is becoming more and more popular every day owing to its portability and the fact that there is no wastage in its use; it is used up even to the last drop. The popularity of motor transport in India, which is a country of long roads, is making the deficiency of petroleum more and more felt. Petroleum is found in India only in Assam.

The petroleum resources of India are confined to the system of folded rocks of the Arakan system on the east, including Assam and extending into Burma and the oil-fields of Sumatra, Java and Borneo. These areas are the sites of ancient gulfs of the old sea Tethys.

The belt of tertiary rocks extending from the north eastern corner of Assam for about 180 miles south and west shows frequent signs of oil, nearly always in association with coal and sometimes associated with brinesprings. The series of earth-folds in which this corner of Assam

occurs stretches southwards to Cachar, where oil springs are also known, through Lushia hills into Arakan. In the same system of parallel folds occur the oilfields of the Arakan coast on the one side, and those of the Irrawaddy valley on the other.

Oil-springs are found in various parts of Assam, the most prominent being those at the southern foot of the Khasi and the Jaintia hills, and those appearing in the coal-bearing rocks in north-east Assam, especially in the Lakhimpur district. The only marketable oil obtained comes from the Lakhimpur district, where systematic drilling is conducted at Digboi. The total output for Assam was about 656 lakh gallons in 1948. The output has been increasing for some time past. The Assam oil is mostly 'shale oil,' that is, it is obtained from sand which is saturated with oil.

The principal products of Assam are petro, jute-batching oil, lubricating oils, paraffin wax and a comparatively low grade of kerosene suitable for bazaar consumption. The paraffin wax is of excellent quality and is sold in the form of candles or is exported to England.

OUTPUT OF DIGBOI REFINERY IN 1938

	(1,000 Gallons)
Kerosene	23,196
Batching and lubricating oil ...	186
Spirit	12,995
Wax	1,590
Sundry oils	5,646

HYDRO-ELECTRICITY

The supplies of coal and oil fuels are deficient in India but there is one fuel of which there is an abundance. This fuel is hydro-electricity. Unfortunately, it is very little harnessed in India, due largely to the industrial backwardness of the country. Heavy rainfall, rough topography to cause water to fall, and a regular and

continuous flow of water are the three important geographical requirements for developing hydro-electri-

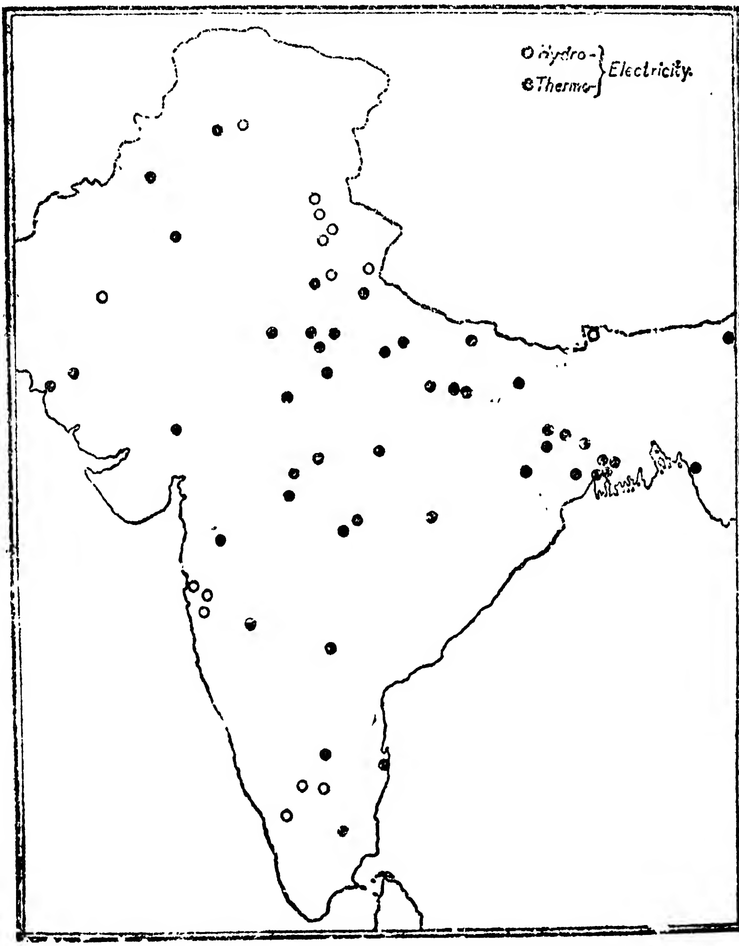

Fig. 39. Centres Generating Electricity.

city. Of these the first two are found over a large part of India, but as regards the third, India is unfavourably situated. The seasonal distribution of rain and its precariousness tend to make the flow of water in streams very irregular. This necessitates making of high masonry

dams to create artificial lakes to feed the power-house regularly. The cost of hydro-electricity is, therefore, higher in India than it is in most other countries. The prices of coal in India are so low that most towns find it cheaper to generate electricity with coal than with water. This is particularly so in the towns of northern India which are easily accessible and near the coalfields.

In the hilly areas and in those parts of the Deccan tableland which are far away from coal, and where waterfalls are numerous, hydro-electricity is being developed where there is demand for it. The larger schemes of hydro-electricity came into existence in India during the first World War when the price of coal was very high and hydro-electricity was, therefore, cheaper.

The hydro-electric works of India can be divided into three classes :—

(1) Those supplying larger industrial or commercial towns ;

(2) Those connected with irrigation works; and

(3) Those supplying the hill-stations.

(1) The examples of hydro-electric works supplying large industrial or commercial towns are :—

(i) The Tata Hydro-Electric Works which have their power-houses near Poona and supply the city of Bombay. The water in the several lakes near Lonavla is harnessed and power transmitted to Bombay over a distance of about 70 miles by overhead wires. These lakes are shown in the accompanying map. There are three power-houses; at Khopoli, Bhivpury and Bhira. The Tata Hydro-Electric Power System sold in 1948 about 990 million units of electricity for about Rs. 50 lakhs.

Besides the above Power Stations, the G. I. P. Ry., owns a small power station at Chola lake in the Western Ghats on the Ulhas river. The textile industry and the town of Bombay use this power. Thana, Kalyan, and Poona also get electricity from these stations.

(ii) The South Indian Hydro-Electric Works, with their pivotal Pykara Works have an important significance

in the economic life, of the Madras Presidency and Mysore. These parts of India are far away removed from coal. Most of the important towns are situated inland, away from the coast. The problem of industrial fuel is, therefore, a serious one. Unlike Bombay, the industrial towns of the interior cannot import coal cheaply. The progress of industry was, therefore, slow

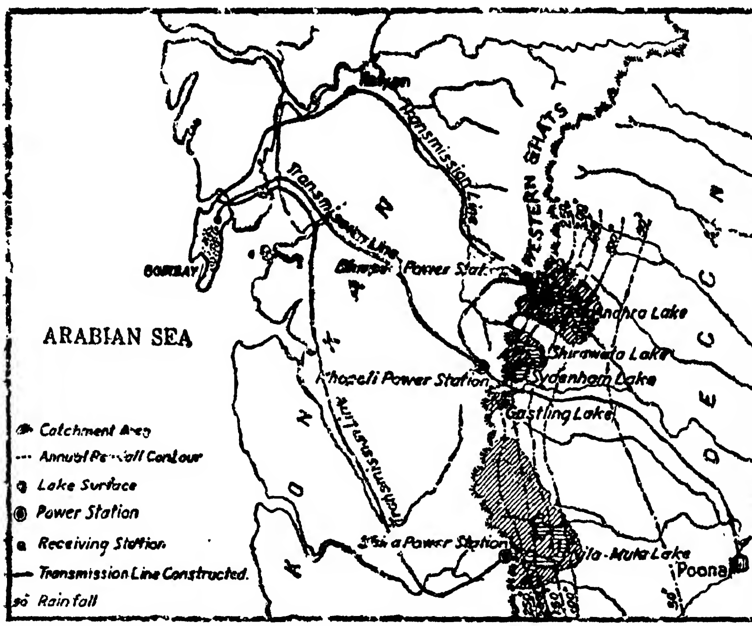

Fig. 40. Tata Hydro-Electric Works.

until the development of hydro-electricity solved this problem partly. Pykara is a household word in Southern India, because it has brought prosperity to a large part of the country. The Pykara site is one of the best for power development in the world, the ultimate capacity is estimated to be 100,000 H. P. Already with the completion of the present extensions the capacity of the plant is raised to 55,000 H. P. The increase in the demand for power in the Tamil country compelled the Madras Government to provide urgently further storage at Mu-

kurti, and additional generating units. The increase in the demand for power was brought about generally by the rapid industrialisation of South India taking advantage of the availability of cheap electric power and particularly by the phenomenal development of the textile industry in Coimbatore.

According to the plans of the Government the Pykara, Mettur and Papanasam Hydro-Electric lines will be interconnected to form an electric grid, because the

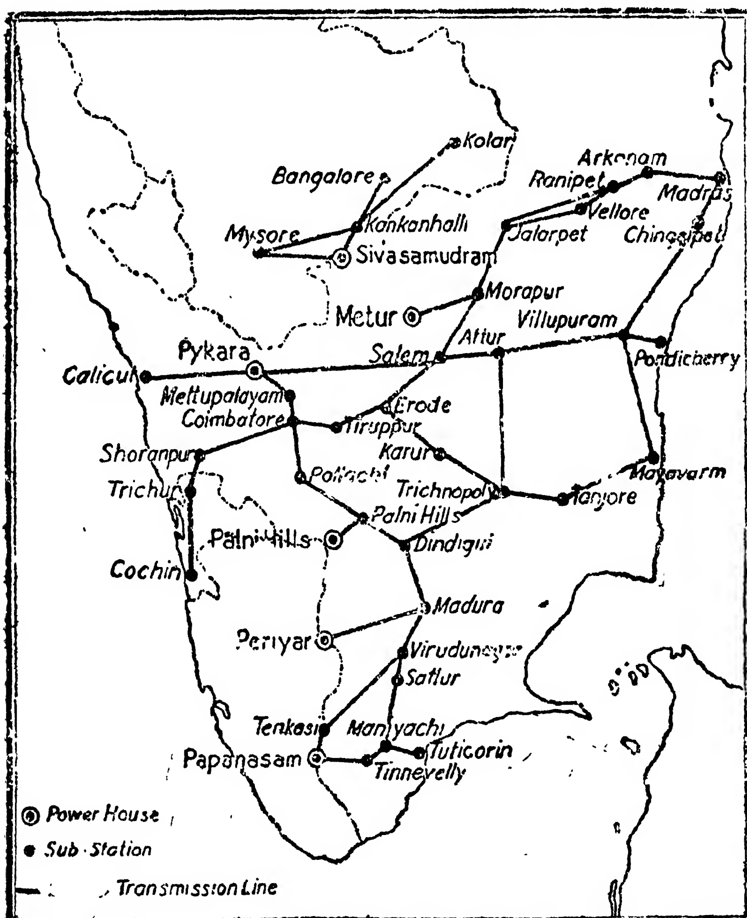

Fig. 41. The South-Indian Hydro-Electric System.

development of textile and other mills at Mettur, with the help of the power generated there from the river Cauveri, was much beyond expectation, and it became clear that Mettur will not be able to meet the demand without assistance from Pykara. The Mettur Dam makes a lake whose catchment area is about 16,000 sq. miles.

This was especially so, because during the irrigation closure period, when water does not run in the canals, the capacity of the Mettur Generating Station drops from 45,000 K. W. to 6,000 K. W. The extension of the Pykara works has, therefore, been hastened.

(iii) The Sivasamudram works were one of the first hydro-electric works to supply industrial power for use in the Kolar Gold Mines situated about 90 miles away. Sivasamudram supplies power to Bangalore and Mysore towns also. Near Mysore another dam has been constructed at the Cauveri making a lake known as "Krishnaraja Sagar." A small amount of power is generated at this dam and is used for working the sluice gates of the canals taken out for irrigation from this Sagar. This dam had been projected by Tipu Sultan ; though it was not constructed in his time. The main purpose of Tipu's project was irrigation. The idea of electricity was unknown then. The Jog falls in Mysore are also being harnessed for electricity.

Alwaye in Travancore is another important centre for hydro-electric development in the south. By 1952 this power station will be producing about 1,09,500 kw. Out of its present production about 20,000 kw. are being sent to places situated in the Madras State. Most of the power generated at Alwaye is used in industries. The following was the distribution of this power in 1950 :—

Industries	61%
Agriculture	13%
Domestic use	13%
Miscellaneous	13%
	100%

The various industries using this power were as follows :—

Aluminium	7500	kw.
Fertilizers	4,000	„
Rayon	2,000	„
Cement	1,600	„
Tea	3,400	„

The above industries using the hydro-electricity of Alwaye are located at Trichur, Alwaye, Kottayam, Alleppy, Qillon, Trivandrum, and Shencottal.

(iv) Outside the Peninsular India, Mandi Hydro-Electric works near Jogendranagar in the Simla Hills are important. The Mandi works were undertaken with very high hopes which have not been fulfilled. They supply power for lighting and domestic purposes to some of the towns in the Punjab. Kangra, Pathankot, Dhariwal, Amritsar, Lahore, Moga, and Jullundar are the chief among these towns.

The Mandi Hydro-Electric works have been started chiefly to supply power from the Uhl river in the Mandi State. This river is a small one (its catchment area is only 147 sq. miles) but carries a very large amount of water. The course of the river has been changed by building a dam across it. The waters impounded by the dam are then passed through a tunnel made in the opposite direction. This tunnel is 14,212 ft. long. From this tunnel the waters are led by means of huge pipes to the electricity generating works situated below in the plains near Jogendranagar. The water falls from a height of 2000 feet. The water, after its use in the works, is released for irrigating this plain.

The power is transferred by means of overhead wires through the hilly area of the Kangra Valley. Practically all the towns situated near the foot of the Himalayas in this section get power from these works. It will be seen from a map of India that most of the towns of the Punjab are situated in this region.

The Railway Workshop at Moghulpura near Lahore is the most important industrial user of the power from these works.

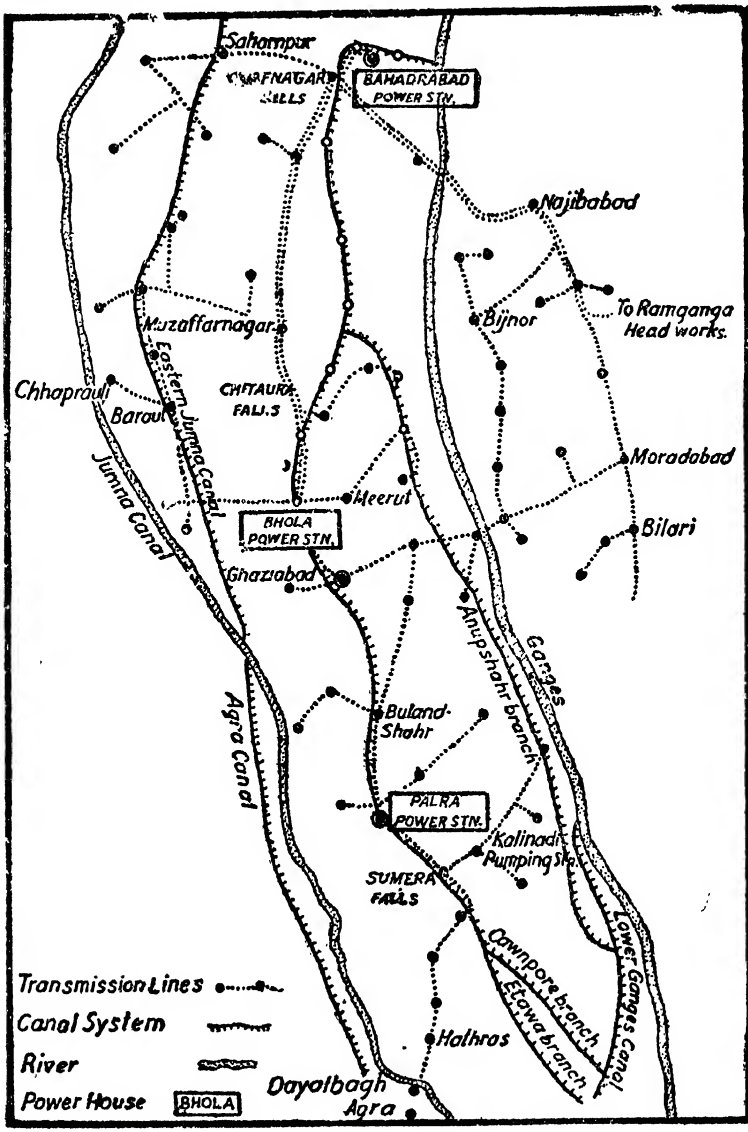

Fig. 42. The Ganga Canal Hydro-Electric System.

The works are handicapped in being situated far away from the populated area of the Indo-Gangetic plains. The means of communication are difficult. The company had to finance the working of the Kangra Valley Railway which was built by the Government of India specially for the use of the works. This railway passes through the hilly area and is, therefore, very expensive to operate. The cost of transport on the material required by the works must, therefore, be very high. The Mandi State or the area round about, is not rich in any kind of industrial raw material. The works cannot, therefore, supply power to any industrial works near about. Their market is really hundreds of miles away.

The Punjab, however, which is the chief market for the Mandi works, is situated very far from coal. This fact alone makes it possible for the Mandi works to carry on profitably.

The Uhl river is producing now about 25,000 kw. The Punjab will get about 10,000 kw. more when the Nangal and Bhakra dams on the Sutlej are completed in 1962.

(v) The Baramulla works in Kashmir must also be noted. The waters of the Jhelum river enter a gorge here and are utilized for generating electricity. The power is supplied to Srinagar and Baramulla.

(2) The most important hydro-electric works connected with irrigation works are those on the Upper Ganga canal. The power is generated from several falls on the Ganga canal. The main power-house is at Bahadurabad, but the power generated at different falls is connected to a grid which serves the towns of western U. P. The above map shows these falls and the towns served by the grid. The Power Stations are situated at Bahadurabad, Mohammadpur, Nirgajni, Chitaura, Salwa, Bhola, Palra, and Sumera. Two thermal stations have also been erected as stand-bys. The Ganga canal system produces annually about 193 million units of electricity every year. The

area served is about 1600 sq. miles spread over fourteen districts of U. P. There are about 95 towns receiving electricity from this system whose transmission lines run far more than 5000 miles. The greatest importance of this grid lies in the fact that it enables extension of irrigation in certain areas which could not formerly be effectively served by the existing Anupshahr Branch of the Ganga canal. Water is now pumped into this branch from the Kalinadi with the help of hydro-electricity. A number of tube-wells have been bored and are now worked with electricity to supply irrigation water to areas which could not be supplied with canal water.

(3) Most of the hill-stations are situated in a region where water-falls are numerous, and the means of communication difficult, so that the transport of coal becomes expensive. These stations find it cheaper to develop hydro-electricity. Practically all the big hill-stations, therefore, develop their own power.

Comparing the position of India with some of the countries of the West, it is clear that the development of hydro-electricity here is insignificant.* This is but natural in the present state of industrial backwardness of the country. The basic importance of hydro-electricity for India must not, however, be lost sight of. Nature has not endowed us with abundant supplies of coal, but she has given us an abundance of 'white coal' whose supplies are inexhaustible in contrast with the supplies of coal which diminish as they are used.

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*Consumption of Electricity per head per year.

Canada	3510	kw.
Norway	3050	"
Sweden	2000	"
Switzerland	1944	"
U. S. A.	1460	"
England	906	"
India	9·06	"
U. P.	6·04	"

Bearing this fact in mind, and also that the development of hydro-electricity is inseparable from the development of irrigation facilities in India, the Government has formulated a number of schemes for developing hydro-electricity in different parts of the country. At present all electricity produced in India is about 5000 million kw. It is proposed under the new plan to raise it by 1956 to 10,000 million kw.

Of all the projects, the Damodar Valley Project is the most ambitious in outlook. For it aims not only at developing power, but also providing irrigation, controlling floods and improving navigability of the Damodar river. In fact, it aims to copy the famous T. V. A. (Tennessee Valley Authority) of the United States of America.

The Damodar Valley Corporation was set up in July 1948 to execute the Damodar Valley Scheme (D.V.A.)

The Damodar Valley Project is intended to control the Damodar river and its tributaries whose floods periodically cause considerable damage. It envisages the construction of a series of 8 dams with hydro-electric installations. Besides these, a 200,000 kw. thermal power station is to be set up as a stand-by for the hydro-stations, A network of canals and transmission lines to distribute the water and the power produced is also to be constructed.

Owing to the shortage of money, material, machinery, and men the scheme has been divided into two phases. The first phase on which work was started two years ago includes the construction of four dams at Tilaiya, Konar, Maithon and Panchet Hill, a thermal station at Bokaro, a transmission system of 470 miles, an irrigation barrage at Durgapur and a network of canals in the lower valley to irrigate over a million acres of land in the districts of Burdwan, Hooghly, Bankura, and 24-Parganas.

The Tilaiya dam is located on the Barakar river about 130 miles above its confluence with the Damodar. The dam is 1147 ft. long with a maximum height of 94 ft.

above the bed level of the river. It will impound about 320,000 acre ft. of water. This water will enable irrigation of nearly one lakh acres of land.

The power plant consists of two sets of 2000 kw. each with provision for an addition of a third set at a later stage. Considerable progress has been made on this section of the project and the dam has risen above river bed level. All the machinery and equipment is at site and the whole work is expected to be completed before September, 1952. This power station will serve Hazaribagh and Kodarma towns and the mica mines. Advance supply of electricity from the construction power house at Tilaiya has been given from last September to promote load development in this area.

The Konar dam on the Konar river is situated about 15 miles above its confluence with the Damodar river. The dam will be 12,700 ft. long. This dam is primarily intended to supply enough cooling water to the Bokaro thermal station, and the generation of about 35,000 kw. of power. Work on this dam was started and scheduled for completion by June 1953.

The Maithon and Panchet Hill dams are intended mainly for flood control. The former is located on the Barakar river and the latter on the Damodar, a few miles above the junction of the two rivers. The Maithon dam will be 1300 ft. long and 165 ft. high. The reservoir formed by this dam will have a controlled storage capacity of over 10 lakh acre ft. and about three-fourth of this capacity is reserved for flood-control. The storage available at Maithon will enable 270,000 acres to be brought under perennial irrigation. The hydro-electric installation will have a total capacity of 40,000 kw. All the preliminary work, including design, has been completed and work on the dam is expected to begin soon.

The Panchet Hill dam will have a power-house with a capacity of 40,000 kw. Investigations regarding stream flows, geological conditions availability of construction

materials and facilities are in progress and work on this dam is expected to be started early next year. When completed the project will enable nearly 7 lakhs acres of land to get irrigation.

Most of the land to be irrigated under the Damodar Valley scheme lies in the lower valley on both sides of the Damodar river. Although rainfall is plentiful in this region, agriculture suffers from a two-fold danger—floods, and failure of rainfall at the required time. With the construction of flood control dams at Maithon and Panchet Hill this danger from floods will be eliminated and the stored water will ensure adequate supply during times of failure of rainfall. An irrigation barrage, 2,305 ft. long at Durgapur will divert the water into two main irrigation canals on either bank and the water will be fed to the fields through a network of canals totalling to nearly 1,500 miles in length. The net irrigable area is estimated at over ten lakh acres, two-thirds of which lie in the Burdwan district and a quarter in the Hooghly district.

The left bank canal and its main branch is also designed to serve as a navigation channel providing an alternative means of communication between the coalfields and Calcutta. The canal will have a minimum depth of 9 feet and will be capable of accommodating two lines of barge traffic. This will go a long way in easing the heavy congestion on railways.

The two dams—Maithon and Panchet Hill and irrigation barrage and the canals are all scheduled to be completed by 1955.

The Bokaro power station will be a thermal power station. The plants consist of three 50,000 kw. turbo-alternators with six boilers. The boilers are designed to burn a low quality coal with an ash content as high as 27%.

The station is located just below the confluence of Konar and Bokaro rivers and ample supply of cooling water is assured by the Konar dam and also by a barrage across the river at the power station site. To keep down

the cost of generation, coal supply to the power station will be from the Corporation's own mines and will be delivered through a 4½-mile aerial ropeway. Construction of the power station has progressed rapidly during the last year. The first set is scheduled for trial by June 1952 followed by other sets at two months' intervals. The station is expected to go into commercial operation early in 1953.

The hydro-electric installations at the various dams and the Bokaro thermal power station of the Damodar Valley Scheme will be linked by many transmission lines. Power will be distributed through an extensive network. The Loyabad-Sindri-Maithon section of the main transmission line (39 miles long) is nearly complete. These lines are being completed urgently to distribute in the coalfield area 22,500 kw. of power which is being obtained from the Sindri Fertilizer Factory Power Station.

This interim measure will afford some relief to the power-starved coalfield and also meet the urgent requirements of power at the Chittaranjan Locomotive Works, the new telephone cable factory and other industries in the area.

Reservoir areas are large. Tilaiya, the smallest dam, will submerge 16,800 acres, or 26 square miles of land of which 8,000 acres are cultivated.

The reservoir will displace 1,500 families. For the affected population land for land and house for house is the accepted principle. Already about 3000 acres of ravine land in the upper valley of the Damodar have been reclaimed for settling the displaced population.

A special feature of the Damodar Valley Project is that benefits accrue as each component part is completed. Thus Tilaiya on completion in June, 1952 will provide water and assure full irrigation of the area now served by the Anderson Weir. With the completion of Konar in 1953 there will be sufficient water to put the whole of this area under Rabi. Power is already being supplied to

the Chittaranjan Locomotive Works and to the Kodarma Mica Mines. The following map gives a rough idea of the project :—

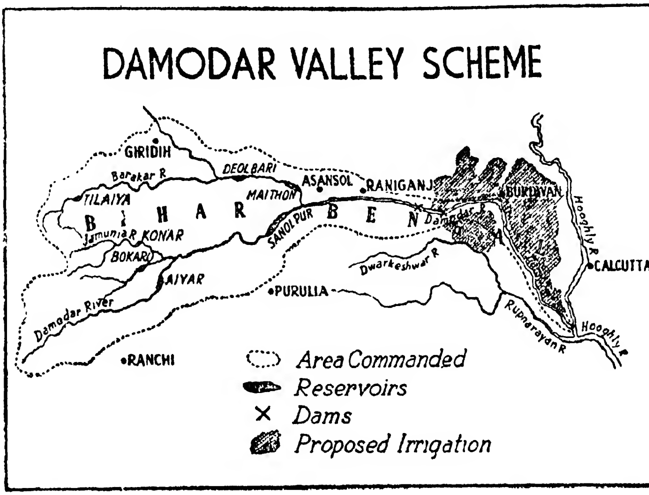

Fig. 43.

There are about 135 river valley projects under execution in this country now. Of these 11 are multi-purpose, 60 are irrigation projects, and 64 are purely power projects. The multi-purpose projects are so called because of the manifold benefits they will confer, such as the internal navigation, soil conservation, afforestation, fish culture, supply of drinking water, development of recreation centres, control of floods, irrigation, and the production of hydro-electric power.

The following are some of the major multi-purpose projects :—

1. The Bhakra-Nangal Project in the Punjab includes the construction of a dam across the Sutlej near Bhakra, about 50 miles away from Rupar in the Ambala district. The height of the dam will be about 680 feet. About 8 miles below this point the Nangal dam, which is 90

feet high, is nearing completion. There will be 3 power stations on the Nangal canal. The two dams will irrigate an area of about 36 lakh acres. The project provides for the generation of 4 lakh kw. of electricity which will serve the Punjab, Pepsu, Rajasthan, Delhi and Uttar Pradesh.

2. The Hirakud Project in Orissa is the first of a chain of three dams planned for the harnessing of the waters of the Mahanadi. At a point about 9 miles from Sambalpur, at Hirakud, the first dam will be constructed on the Mahanadi. The second dam on this river will be at Tikkarpara, and the third at Naraj. Later on, dams will be constructed on the Ibb and the Mand which are the northern tributaries of the Mahanadi; and on the Tel river which is its southern tributary. The Hirakud Project provides for the irrigation of about 11 lakh acres, beginning in 1953-54. When fully developed the Project will provide 321,000 kw. of electricity of which 24,000 kw. will be available in 1952-53. This electricity will be used for the industries at Jamshedpur. The Hirakud Dam will provide not only adequate flood protection to the Mahanadi delta but also improve appreciably the navigability of the river.

3. The Tungabhadra Project envisages a dam across the Tungabhadra river near Mallapuram, 3 miles above Hospet, in Bellary district. This Project will serve Madras and Hyderabad. There will be 2 canals, one will irrigate about 3 lakh acres in Madras and the other about 419,000 acres in Hyderabad. The power generation is expected to be about 155,000 kw. The Project is likely to be completed in 1953.

4. The Machkund Hydro-electric Project will harness the waters of the Machkund on the boundary between Madras and Orissa, and will be administered jointly by the two States. The site of the power-house is at Duduma Falls, about 125 miles from Visakhapatnam by road. There will be three generating plants, each capable of generating 17,350 kw. of electricity.

5. The Kakrapara Project in Bombay State consists of a dam across the Tapti at Kakrapara, 50 miles above Surat. The Project provides for two canals, one on each bank of the river. The area to be irrigated will be about 5½ lakh acres, and the power generated is expected to be 48,000 kw.

Among the other major Projects may be named the the Sarda power project in Uttar Pradesh, the Mayurakshi irrigation-power project in West Bengal, the Chambal irrigation-power project in Madhya Bharat and Rajasthan, the Lakkavali irrigation-power project in Mysore, and the Kosi Project in Bihar. In addition, there are about 123 power and irrigation projects in different parts of the country.

In 1947, only 1295 villages, with a population of less than 5000 each, were electrified. In 1949, this number rose of 2118. In other words, 38 out of every 10,000 such villages in this country now receive electricity.

Power in M. P.

Madhya Pradesh is one of the richest states of Indian Republic in mineral resources, and yet it is one of the most backward in Power Development. Nature has endowed it with both basic and key materials such as iron, coal bauxite, manganese, etc. Coal is found in abundance. The coal deposits of the state occur in three areas :—(i) the Pench-Kanhan Valley, approximately 100 miles to the north of Nagpur, (ii) the Wardha basin, about 100 miles to the south of Nagpur, and (iii) the Chirimiri region in the eastern part of the state. These are at present being worked. The coal deposits found in the vicinity of Nagpur and Kamptee are yet to be worked. The state has an assured rainfall. Its river systems—the Narmada, the Tapti, the Mahanadi, the Wardha, the Wainganga, the Indravati—offer opportunities for multi-purpose development yielding power and irrigation.

But the pre-conditions of any developmental plan is the availability of cheap power. The harnessing of the state river system could no doubt form the major source

of power-generation, but it is easentially a long-term measure. Large outlay is involved necessitating building up in advance a large electrical load and efforts to utilise any surplus power that may be there. Recent load surveys of Madhya Pradesh indicate a load potential of 2,40,000 kw. prospective and 1,29,000 kw. firm by 1955 and 3,46,000 kw. prospective and 1,61,700 kw. firm by 1960. The load consists of textile mills, ginning and pressing of cotton, rice mills, oil mills, hydro-generation of oil industry, paper mills, cement mills, newsprint and paper mills, manganese mining, collieries, alluminium, and steel and other industries.

But so far the development of electric supply in the state has been very slow. Introduced first for publc supply in 1902 the total installed capacity of public supply undertakings in Madhya Pradesh upto 1938-39 was only 11,030 kw. This was stepped up later for war-purposes during the period 1939-1944. The present capacity is 26,485 kw. The bulk of this is concentrated at Nagpur, Jabalpur and Katni. The state as a whole, however, still remains badly power-starved. The total capacity of private-owned electricity installations is 29,484 kw., making an over-all availability of power in the state to the extent of 55,969 kw. only. There is still a big gap between the supply and the demand for power. This cannot continue without deteriment to the economic and industrial progress of the state.

As an immediate measure, therefore, Government decided to develop thermal power scheme and in 1945 invited the eminent electrical engineer, Sir Henry Howard from Madras to formulate an appropriate plan. Some of his principal recommendations were as follows:—
(1) to divide the state into five power-districts—Nagpur, Chanda, Akola, Jabalpur (northern) and Raipur. (2) A power system in each district based on existing loads from suitably located thermal stations in each district. (3) These to be inter-connected at a future date by trunk mains and neighbouring systems across the state border.

Accepting the recommendations in principle, the Government announced their decision in 1945 of establishing a central thermal electrical station near Nagpur with an installed capacity of 20,000 kw. capable of future expansion to 60,000 kw.

As a pre-requisite for such a development was evolved a five-year development plan ending in 1952 for providing the nucleus of a State electricity supply system to cover as wide an area as possible in the quickest possible time and ensure a reasonably cheap and abundant supply of electricity. For purposes of power development the M.P. is divided into 3 grid systems—southern, northern, and eastern. They are at the moment independent, each fed by one or more central thermal stations, to be later interconnected by provincial trunk mains, to the sources of water-power potential and to neighbouring systems at state borders. Work is in progress on all these schemes and they are expected to be commissioned one after another commencing from 1951. Places not reached by the nucleus grid will be developed by setting up small local thermal (diesel) generating stations and be later linked to the grid schemes. The aim here is to provide electricity to towns having a population of 10,000 and over, and to as many of major villages as possible, in course of time. Besides, the Government have a scheme under consideration for intensive rural electrification in certain selected areas.

The Khaperkheda station forms part of the southern grid system. Situated on the right bank of the Kanhan river approximately four miles from Kamptee and ten miles from Nagpur, it has direct rail connection with the Pench valley coalfields in the north, and the Wardha basin in the south. Enough coal deposits exist in and around the site, working is not difficult and cost of coal will be cheap. Water in the river is plentiful and permits of enlarging the station to any reasonable degree. In such a set-up, the Khaperkheda station is designed to operate as a base. In planning the station the Government have also

in view the growth of industries in the vicinity. They have, therefore, provided for a planned township.

With an operational capacity of 20,000 kw., the load-expectation within the next 5 years from the power station is 42,900 kw., when it starts functioning, 16 new towns will, for the first time, begin to receive electricity ; 11 out of the 16 electric supply companies in the areas served by the station will have stopped generation although continuing as distributing units ; out of the 9 textile mills within its range, 4 with 12,000 kw. and approximately 1000 hp. requirement will be changed over to the grid supply and all the 4 private generating stations in the coalfields with an installed capacity of 32,00 kw. and the new major mines not yet electrified requiring another 2,000 kw. (practically all the Pench fields and Wardha basin) will begin to be fed by this central station.

The station is expected to rationalise the power situation in the state. Together with the projected station in the Chanda-Ballarshah power district and the station at Chandni to which it will be interconnected, Khaperkheda will make available an economical and widespread supply of electricity in the Nagpur and Berar divisions or in other words, the southern and western parts of the state. Power-feeders take off from the station in all the four directions—to Pench Valley in the north ; to Akola, west Berar and Nimar in the west (in association with Chandni station) ; to Ballarshah in the south branching from Wardha ; and to the manganese belt in the east which will in course of time extend to the Balaghat-Baihar plateau and the Bhandara district. The mining and textile industries and the electric supply companies have already taken advantage of it and are fast entering into contracts for supply from the Government grid. In fact, the entire capacity of the Khaperkheda station is already fully booked.

The towns that will receive electricity supply for the first time from the station are Ramtek, Tumsar, Bhandara, Kamptee-Kanhan, Warora, Wun, Ballarpur, Pulgaon, Dhamangaon, Badnera, Murtizapur, Achalpur, Saoner,

Khapa, Sausar and Jamai-Parasia. An extension of the supply to the rural parts immediately in the Saoner Katol-Warud area is under active consideration. The Government grid scheme is intended to supply electricity by and by to all rural areas on a planned development in zones of 20-mile radius around each main sub-station location.

The following table compiled from the Central Water Power-Irrigation Commission under Shri A. N. Khosla gives an idea of the greatness of our potential resources on the one hand, and the backwardness of their exploitation on the other hand. It is clear that we are at present using only 5·6% of the total run-off of the rivers for irrigation. This may be compared with 40 % in the case of the Nile in Egypt.

WATER RESOURCES OF INDIA

	C. area sq. miles (000)	Normal Rain in inches.	Mean Tem. F.	Loss (inches)	Run off (inches	Run off. (Mil. Acre Ft.) Annual.	Used for Irrigation (Mil. Acre Feet)
1. Rivers falling into Arbian Sea (Exc. Indus).	190	48	78	23	25	251	11
2. Indus Basin in India.	136	22	55	13	9	64	11
3. Rivers falling in Bay of Bengal (Exc. Ganga & Brahmputra).	467	42	79	29	13	334	23
4. Ganga system	377	44	62	24	20	397	26
5. Brahmputra System	195	48	47	18	30	309	3
6. Rajasthan	65	11	79	11	...	...	...
	1430					1356	74

QUESTIONS

1. How far do you think the power resources of India to be sufficient for her industrial needs ?

2. What is the extent of coal resources in India ? Where are the main deposits of coal in India found ? Why ?

3. What geographical or economic drawbacks has the Indian coal industry to face ? What remedies can you suggest ?

4. What is the extent of Petroleum resources in India ?

5. Where is hydro-electricity developed in India most ? What factors favour it there ?

6. On what grounds will you recommend greater use of soft coke in Indian homes ?

7. Describe and explain the utilization of water-power resources in India with special refesence to the Punjab.

8. Describe the geographical factors involved in the use of hydro-electric power in India.

CHAPTER VIII

INDUSTRIAL ORES

Metallic ores occupy the basic position in the economic life of the modern world. There are numerous uses to which the ores are put, but their greatest use is in the manufacture of machinery without which the wheels of the world cannot go on. The ores are found associated with the oldest rocks of the world. Here in India the system of rocks named 'DHARWARIAN' is the most widely occurring of such rocks. It is probably of the same age as the Archaen rocks which are believed to be the first solidified crust of the earth. The Dharwar system of rocks carries the principal ore-deposits of India. This rock occurs mostly in the Peninsular part of India.

IRON

Bihar, Orissa and Mysore are the only parts of India in which large quantities of iron-ore are mined. Elsewhere, specially in Hyderabad and Madhya Pradesh small quantities are mined for use in indigenous iron works. The most important iron-ore area in India is situated about 150 to 200 miles to the west of Calcutta in Bihar and Orissa, and contains large and rich deposits of iron-ore. The deposits occur in the Kolhan Government Estate in the Singhbhum district, and also in Keonjhar Bonai and Myurbhanj. These ores are remarkable for the enormous quantities of extremely rich ore which will one day undoubtedly prove to be among the largest and the richest in the world. The iron ore usually occurs at or near the tops of hills. Near Jamda in the south of the Singhbhum district and in parts of the Keonjhar State, however, it is often found at lower slopes and in some cases actually in the plains themselves.

The most important of these ranges of hills containing iron-ore is the one that starts near Kompilai in Bonai and continues for a distance of about 30 miles towards Gua. Running more or less parallel to this range, and possibly faulted from it, are other smaller ranges which contain good iron-ore. The main range rises some 1,500 ft. above the plain and the ore averages over 60% of iron for practically the whole length of it. To the east and west of these hill ranges, there are more irregular patches of ore occupying the tops of hills. Practically

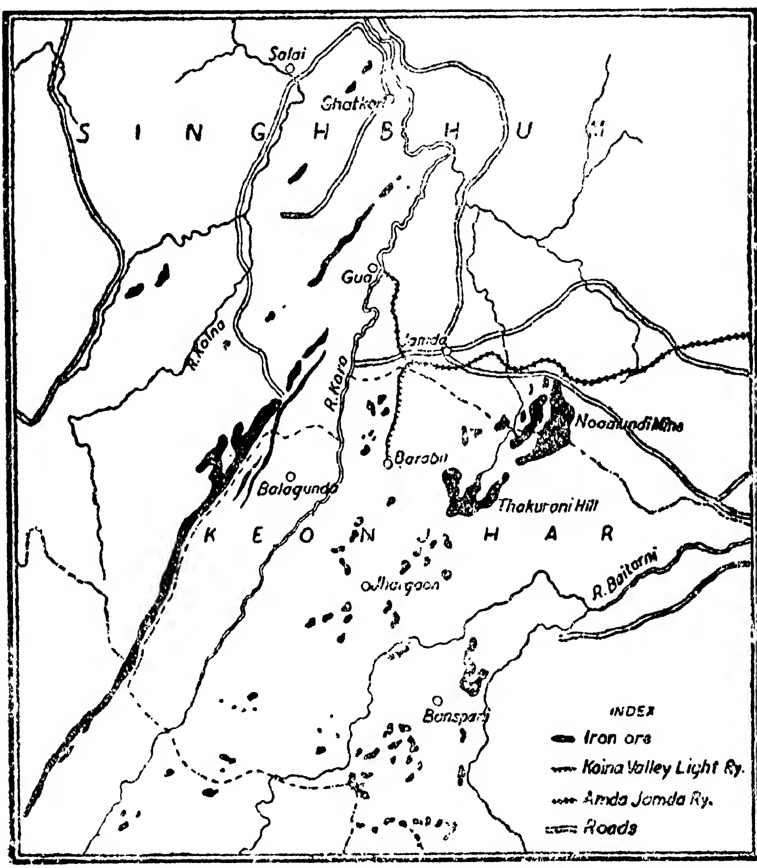

Fig. 44. Showing Iron-Ore Region of India.

the whole of the ore is hematite and, as far as is known, no quantity of magnetite occurs there.

The minimum quantities of ore reserves averaging not less than 60% iron are estimated as follows :—

Singhbhum District	1,047	Million	Tons
Keonjhar	988	"	"
Bonai	648	"	"
Mayurbhanj	18	"	"

In Singhbhum district the iron-ore is mined in Kolhan where the important places are Pansira Buru, Gua, Buda Buru and Noamundi. In Mayurbhanj the important places are Gurumahisani, Sulaipat and Badampahar.

The Bengal Iron Co., Ltd., with their works at Kulti, the Indian Iron & Steel Co., Ltd., with their works at Burnpore and Tata Iron & Steel Co., Ltd., with their works at Jamshedpur, are the most important users of Indian iron-ore. The Indian Iron & Steel Co., Ltd., take their ore from the mines situated at Gua in Kolhan. A branch line of the B. N. Ry. carries all the ore from these mines.

The Tata Iron & Steel Co. also possess rich ores in Kolhan and in Keonjhar. But prior to 1926 when Noamundi iron mine in Kolhan was opened, practically the whole of the supplies of iron-ore for the Tata's came from their deposits in Mayurbhanj, which are nearest to the site of the works and to which the B. N. Ry. runs a branch line, about 56 miles in length. The three most important deposits of Mayurbhanj are :—

(1) Gurumahisani (Gurumaishini);

(2) Okampad (Sulaipat), and

(3) Badampahar. The ores here are of the same type as those of Singhbhum and Orissa.

(1) The Gurumahisani hill mass, with its three prominent peaks and its numerous flanks and spurs, forms a conspicuous feature (See Fig. 45) of the northern part of Mayurbhanj. On the north side, the lower slopes of the hill have now been worked out and practically no ore remains below a height of about 400 feet above the plain level, but south of the main peak the ore is still unworked down to the foot of the hill. The average iron content of the Gurumahisani ore is 63 p. c.

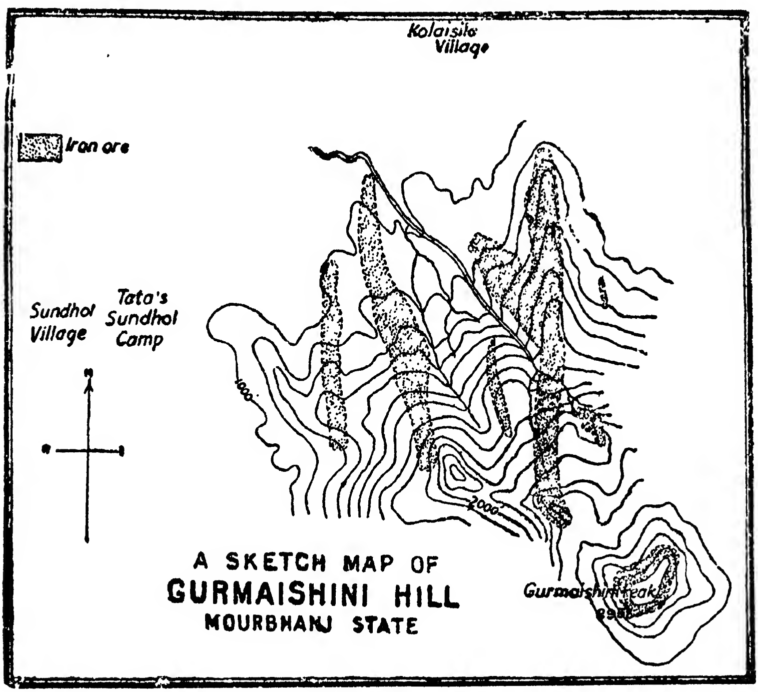

Fig. 45.

(2) The Okampad (Sulaipat) ore deposit is situated just west of the Khorkai river. Sulaipat ore is richer than Gurumahisani ore ; it has about 67% metal content. The main ore body occurs on the top of the hill.

(3) The Badampahar ore deposit is neither so large nor so rich in iron as the ores of Sulaipat and Gurumahisani. It is, however, more porous and is highly valued on that account in spite of the lower iron content (56 to 58 p. c.).

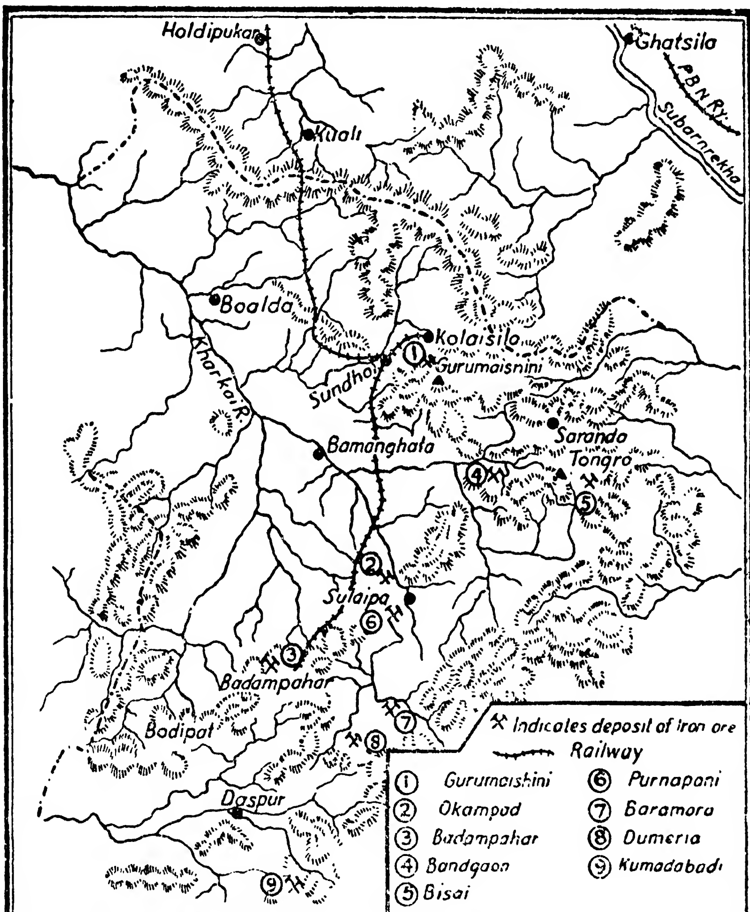

Fig. 46. Showing important Iron Mines.

The Tata Company's Noamundi Iron Mine is in Kolhan. The ore occurs in thick bedded deposits of haematite, averaging well over 60 p. c. iron. The ore is

found on two main parallel ridges rising to a maximum height of about 1,000 ft. above the railway level. The ore at the surface is either hard, massive or laminated. Below 100 feet in depth it appears to be largely powdery ore, but at places it passes into powdery ore at quite shallow depths.

The Bengal Iron Co. also draws its iron supplies now from Kolhan. The principal deposits are known as Pansira Buru and Buda Buru near Manharpur Station of the B. N. Ry. The total quantity of the ore in Pansira Buru has been estimated at 10 million tons, that is, more than that of Gurumahisani ; whilst the estimates for Buda Buru are tremendous, about 150 million tons. The ore is generally a high-grade haematite with an average content of 64 p. c. iron.

In Mysore, the haematite ores of the Bababudan hill are the most abundant and are of good quality, but they vary considerably in their metal content and the amount of phosphorus they contain. The main source of the ore supply for the Bhadravati Iron Works of Mysore is the Kemmangundi ore-field, about 26 miles south of Bhadravati. The average analysis of the high-grade ore gives 64 % iron, but medium and low-grade ores vary from 53 to 58 p. c. iron. The reserves are estimated at 25 to 60 million tons.

Rich ores occur in Madhya Pradesh and Madras, but they are worked very little, being far away from coal. In the Drug district of Madhya Pradesh the ores, on account of their resistance to weathering agents, stand up as conspicuous hillocks in the general plain. The most remarkable is the ridge which includes the Dhali and Rajhara hills, extending for about 20 miles in a zigzag line, and rising to about 400 feet above the general level of the flat country around. In places thick masses of comparatively pure haematite are found. One such place is the Rajhara hill. It is estimated that about 7½ million tons of ore, carrying about 67·5 p. c. of iron are found here. The quantity estimated is for the ore that is visible

on the surface. There may be more in the depths not yet proved.

In the Chanda District of M. P. the iron ore forms a hill three-eighths of a mile in length, 600 feet in breadth and 120 ft. high. This hill is called the Lohara hill. The average Lohara ore contains 61 to 67 p. c. iron.

The ore found in Madras (Salem and Nellore districts) is different in kind from the one found in Orissa or M. P. This ore is magnetite. The principal occurrences are those of (1) Godamalai, (2) Thalamalai-Kolimalai, (3) Singapati, (4) Thirtamalai, and (5) Kanjamalai. The total quantity of ore here is considered to be 'practically inexhaustible.'* The scarcity of fuel, however, makes it impossible to work these ores on a large scale.

The following were the chief areas of iron ore production in 1947 :—

Singhbhum	12 Lakh tons
Mayurbhanj	9 ,,
Keonjhar	3 ,,
Mysore	0 ,,
Chanda	0 ,,

The total production of iron ore in India amounted to about 2 million tons in 1948. This amount was insignificant when compared with the important producers of the world. About half of the Indian production came from Singhbhum district. By far the largest share of the production went to the Tatas.

IRON-ORE PRODUCTION, 1948

Bihar	11 Lakh tons
Orissa	10 ,,
Mysore	½ ,,

*Brochure on iron-ore, *Imperial Mineral Resources Bureau.*

Manganese

The occurrence of manganese is widespread all over the Peninsula. India's position in respect of manganese production in the world is second only to that of Russia. Our ores, which average 50 p. c. or more, are richer in manganese content than the Russian ores whose average is about 45 p. c. The prosperity of manganese mining is closely related to the production of steel, because the main use of the manganese ore is in that industry. India is not a large producer of steel and the manganese miner in India, therefore, has to look to the steel producer of Europe or America. The output from 1929 to 1933 was 2·79 million tons of which 2·72 million tons was exported. In 1948 the production amounted to about 5 lakh tons only. Russia was able to outsell India. The production was distributed as follows :—

Manganese Production, 1948 (000 tons)

Madhya Pradesh	333
Orissa	80
Madras	70
Bihar	19
Bombay	17
Rajasthan	2
Mysore	1

The manganese deposits are in different parts of the Deccan. The most important ones are :—

(1) In Madhya Pradesh—Nagpur, Balaghat, Bhandara and Chhindwara districts ;

(2) In Bombay state —Panch Mahals, Chhota Udepur, North Kanara and Ratnagiri ;

(3) In Mysore—Chitaldrug, Kadur, Shimoga and Tumkur ;

(4) In Madras—Bellary, Sandur State and Vizagapatam ;

(5) In Orissa—Gangpur and Keonjhar.

(6) In Bihar—Singhbhum.

Besides these areas, manganese ore also occurs mixed with the laterite.

The iron ores and the manganese ores are similar. There are some ores in which the proportion of manganese is considerable. These ores are called manganiferous iron ores. The dividing line between the manganiferous iron-ores and the manganese ores is now taken at 40 p. c. manganese content. In the U. S. A. this limit is at 35 p. c. only . Ores with less than 5 p. c. manganese content are called iron ores.

India's proportion of world production of the manganese has varied from time to time owing to the appearance of new producers. The following table gives the proportion of India's output to total world output :—

Period	India's share %	World's Annual Output (Million Tons)
Quinquennium 1909—13	41	1·7
„ During 1914—18	34	1·6
„ 1919—24	43	1·4
„ 1924—28	33	2 8
„ 1929—33	22	2·4

During 1924-28 the production in India rose to a figure never previously attained, yet the Indian proportion fell on account of the increase in the world output.

Most of the exports go to Great Britain. Other countries taking our manganese ore are France, Japan, Belgium and Germany.

There is a steady consumption of the manganese ore at the works of the three principal iron and steel companies, not only for use in the steel furnaces and for the manufacture of ferro-manganese; but also for addition to the blast furnace charge in the manufacture of pig iron. The consumption in India for this purpose in 1934 was 43 thousand tons, or about one-tenth of the total Indian production.

Manganese ore is a true "Jack-of-all-trades" among industrial minerals. It is used in porcelain enamel, dry batteries, building brick, glazed pottery, plastics, welding rod, chemicals, varnish and floor tile. The steel industry is, however, the largest consumer, taking more than 90 p. c. of the world output.

MICA

The chief mica-mining areas in India are those of Hazaribagh in Bihar and Nellore in Madras. Mica has also been obtained from workings in the Eranial taluk of Travancore, the Hassan district of Mysore and Ajmer in Rajputana.

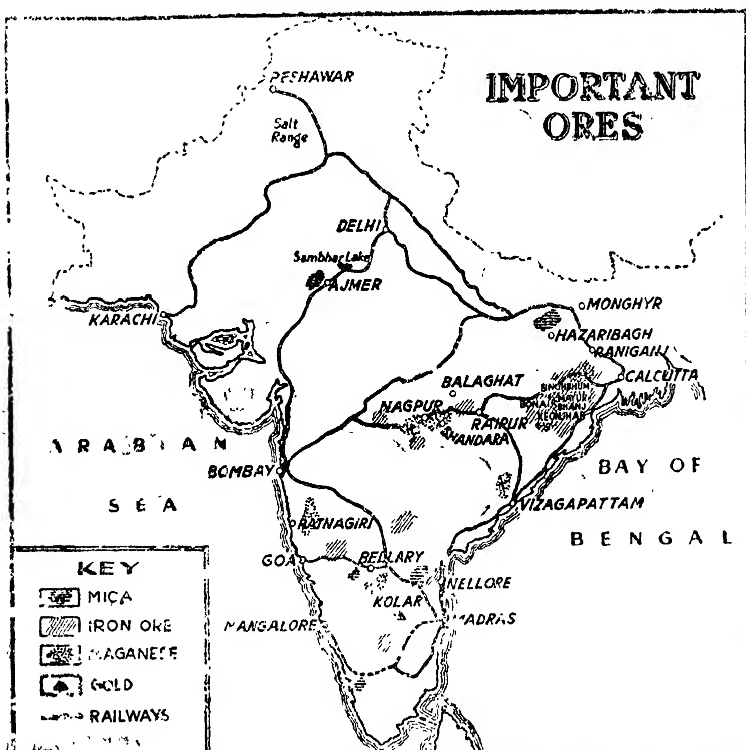

Fig. 47. Indian Ores.

The 'Mica Belt' of Bihar obliquely traverses the districts of Gaya, Hazaribagh and Monghyr, along a strip about 12 miles broad and over 60 miles long. A large number of the more important workings are situated either in, or near, Kodarma forest. By far the larger proportion of the Indian output of mica is obtained from the Bihar Mica Belt, although the mica is often commercially spoken of as 'Bengal Mica'. The mica mines of the Nellore district of Madras are situated on the eastern half of the Madras coastal plain over a tract of country some 60 miles long and 8 to 10 miles broad. Madras mica has a characteristically green colour.

The chief use of mica is for electrical purposes as an insulator. Formerly only larger sizes of mica were in use, but during the War smaller sizes also became marketable. This is largely due to the development of the micanite industry. Micanite is really the built-up sheets of the smallest and thinnest films of mica which are cemented together with shellac dissolved in spirit. The micanite sheets can be built to any size and thickness. They require to be steamed, pressed and rolled, and then can be moulded to any desired shape. India has practically a monopoly of mica and shellac used in making micanite. And yet micanite is not manufactured in India for want of industrial development, especially that of electrical industry.

Practically the whole of the mica produced here is exported to Great Britain, United States, Germany and France.

The financial turnover of the mica industry is small compared to major industries of India. It is concentrated in four or five districts in India, in Hazaribagh, Gaya and Monghyr in Bihar. in Nellore and in Rajasthan. In Bihar is concentrated the main source of muscovite mica, so indispensable for electrical, auto and aero industry and which is the only raw material which was carried by air from India at a cost of about Rs. 4,000 per maund during the First World War.

The workers employed in mining and manufacturing of mica exceed over two lakhs all over India of which one lakh and a half is concentrated in Bihar alone. The quality of mica mined from Bihar, as well as the unrivalled skill of the Bihar workers have placed the mica industry on a semi-monopolistic basis in the world. Although deposits in South Africa, Brazil, Canada and Russia have sought to undermine its position, yet predominance of the Indian mica industry is beyond question even now.

The following table gives the Mica exports from India :—

	(Quantity 000 tons)	Value (lakh Rs.)
1948	360	614
1949	270	571

Copper

There are evidences of copper having been mined in India in the past over a very large part. In the Singhbhum district of Bihar a copper bearing belt, marked out by old workings, persists for about 80 miles, extending from Duarparam on the Bahmini river in an easterly direction through Kharsawan into Dhalbhum, where it curves round to south-east, running through Rajdoha and Matigara to Bhairagora. The copper ores in India occur as indefinite lodes inter-bedded with other rocks. Sometimes the ore is collected into fairly well-defined bands, but very frequently it occurs in the form of grains so sparsely distributed through a considerable thickness of hard rocks as to be unworkable. When concentrated into definite lodes, as at Matigara or Mosaboni, the ore may be of high grade.

The most important copper works in India belong to the Indian Copper Corporation at Maubhandar, Ghatsila. This company converts into brass .sheets with the help of zinc, any copper that it cannot sell as ingots in India.

Two parallel ore deposits have been developed in the Mosaboni mine. The grade of ore here varies from 2·5 to 3 p. c. of copper. There is also a little production

from Dhobani where a deposit parallel to that at Mosaboni is being opened up. Compared with the world production of copper. Indian production is insignificant. In 1948 Indian production amounted to 3 lakh tons.

SALT

The salt produced in India is obtained from two main sources: (i) sea water; and (ii) brine in the lakes of inland drainage, especially the Sambhar lake. About two-thirds of the salt made in India is obtained from sea water, chiefly in Bombay and Madras; very little industrial use is made of Indian salt, as the production of salt in India consists of the so-called 'common salt' and not of industrial salts.

The only industrial salt produced in India is saltpetre coming from Bihar and U. P.

As the production of common salt and its commerce has a great political significance for the people of India—the famous Dandi March of Mahatma Gandhi is a landmark in the history of Indian freedom—we give below a detailed account of the salt production in India.

Ideal conditions for salt-making are :—

(i) Proximity to the sea to have easy access to brine,
(ii) Scanty or no rainfall,
(iii) Strong insolation, which in turn depends on cloudless skies,
(iv) Moderate to strong winds,
(v) Moderate to high air temperature with large deficiencies of moisture,
(vi) Moderate to high evaporation which depends upon the foregoing factors.

From this point of view the following are suitable areas for salt-making in India :—

(i) The Kathiawar coast.
(ii) Southern half of the Coromondal Coast, between Nagapatam and Cape Comorin;
(iii) North Madras Coast between Nellore and Gopalpur,

(iv) The Shambhar Lake.

The following table* compares the climatic conditions found in the salt-making centres in the above areas :—

	Annual Rain	No. of Rainy days	Mean Air Temp.	Mean-Humidity	Mean Evaporation
Dwarka ...	13·52″	20	78	75	98·12
Pamban ...	37″	30	82	75	88·40
Gopalpur...	44·96	60	80	75	89·58

The largest production of salt in India is from the western coast. Bombay State ranks first in salt production. Most of the salt in Bombay is made by the direct solar evaporation of sea water. The factories at Dharsana and Chharvada on the eastern side of the Gulf of Cambay near Bulsar belong to the Government and are worked by it. The other sea salt works are grouped within a radius of thirty miles of the city of Bombay. Those which are owned by the Government are leased to private persons for working; while the others are owned and worked privately. A site for a salt works is chosen generally below the level of high water in spring tides and surrounded by a strong embankment. Within this are situated the outer and inner reservoir and the 'pan' area. The outer reservoir is filled when the tide is high; from it the water flows to the inner reservoir, and thence to the crystallising pans. The floors of the crystallising pans in Bombay, and elsewhere generally, have their floors levelled and tamped with clay which gives the muddy colour to salt. After a few days when a layer of salt, about a quarter of an inch thick, has formed on the bed of pan, it is raked to the edges of

*Scientific Notes, Met. Deptt., India, Vol. VI. 1935.

the pan, washed, allowed to dry and then separated into different sizes. The pan is filled again with water and the process repeated.

The season of manufacture varies with the south-west monsoon, January to June being the normal period.

A considerable proportion of the Bombay salt is Baragra of Rann salt, made from salt water derived from wells on the little Rann of Cutch. The largest works at the Rann are at Kharagoda. There the salt water is obtained from circular wells about 9 feet in diameter and about 18 to 30 feet deep. The manufacturing season here lasts from November to April.

On the east coast, salt is manufactured in the Madras State much on the same lines as in Bombay. The sea water is usually brought from tidal back-waters through channel, from which it is baled into condensing beds. In some works the pans are irrigated several times before the layer of salt crystals is removed, but the 'single irrigation' system is the most common. The season of manufacture varies according as the salt works are subject to the south-west or the north-east monsoon. In the northern districts, manufacture commences in January or February and continues till June or July, when the rains begin. In the South, manufacture commences later, in March or April, and continues upto October or November. Madras salt is consumed locally, and some of it is exported to Ceylon.

The whole of the desert region of Rajasthan is impregnated with salt from the coast of Cutch, north and north eastwards to the borders of Delhi. In this area there are many temporary or permanent salt lakes, as for example, the Sambhar and Didwana, which are utilised for salt making; while in other places sub-soil salt water is raised, as at Pachbadra. Most of the salt in this region appears to be brought in as fine dust by the strong winds which blow from the south-west during summer. These winds blow across the salt-incrusted Rann of Cutch, and carry away sea-spray and finely-powdered

salt in large quantities into the heart of Rajasthan where it remains deposited until the monsoon brings enough rain to wash it into the small lakes in the areas of internal drainage.

The Sambhar is the largest of these salt lakes and covers an area of about 90 square miles at its highest level, but dwindles, generally, to a small puddle by March or April. The mud forming the bed of the lake contains on an average about 5% of salt down to a depth of at least twelve feet. When the lake dries up, salt water contained in its clay bed rises to the surface by capillary action and is evaporated there.

A big dam has been built across the lake near the Sambhar town, and water from the main lake is pumped into a reservoir thus formed. From this reservoir it is transferred to smaller reservoirs and thence to evaporating pans. More than three-fourths of the Sambhar salt is consumed in U. P. and Rajasthan.

The largest production of salt in India is from the Sambhar Lake which yields about 7,000,000 mds. of salt annually.

The total area of salt pans in India amounts to about 55,000 acres. These pans produce about 26 lakh tons of salt in 1950. The consumption of salt in India is mainly for human food. A.small amount is also given to animals. The use of salt for industrial purposes is negligible here owing to industrial backwardness. That is why the per head consumption of salt here in 1948 amounted to 8 lbs. as compared to the world's average of 30 lbs.

Gold

India is very poor in precious ores. Silver is entirely absent, while only a small amount of gold occurs in a corner of the Deccan tableland. Practically all the gold mined in India comes from the Kolar field in Mysore. In the Kolar field there is a single vein or reef averaging only some four feet in thickness in which gold occurs for a distance of about five miles. The deepest mines

are champion reef and Urigam which have each reached a depth of considerably over 6,500 feet measured vertically. This is the greatest depth of a gold mine in the whole of the world. Owing to great depths the problem of ventilation is a serious one in these mines. The temperatures in the lower workings range from 118° F. to 122° F. This depth is also responsible for the large number of accidents that occur in the mines owing to rock bursts. The mines are supplied with electricity from Siva Samudram on the Cauvery.

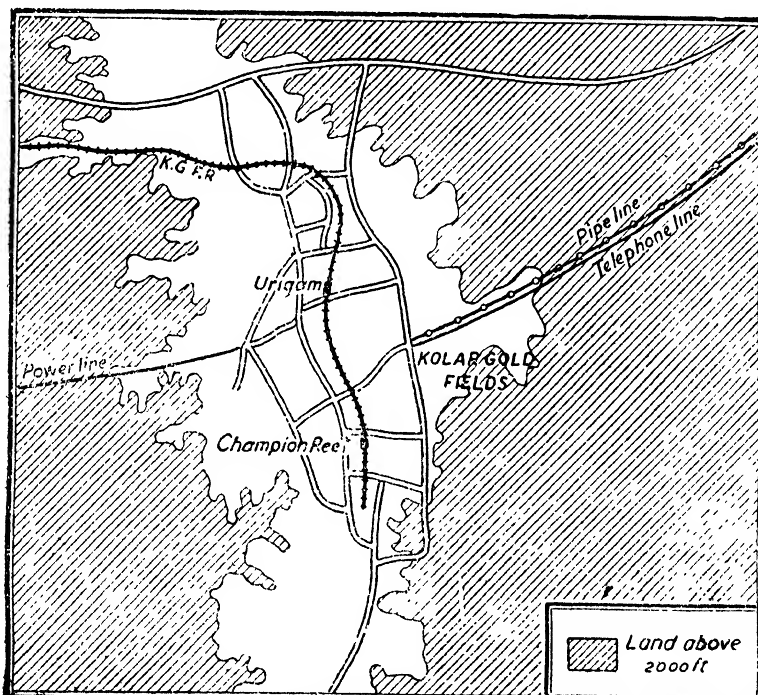

Fig. 48. Showing Gold Mines near Mysore.

Besides this vein gold, a little alluvial gold is also washed from the sand of the rivers of Assam and Orissa.

In 1948 about 52,600 oz. of gold were obtained from ore weighing more than 1 lakh tons (about 1 oz. of gold from 2 tons of rock).

The following sketch shows the Kolar gold mines :—

Apart from the minerals and metals mentioned in the foregoing pages, large quantities of clay, limestone, bauxite and others are quarried in India. In 1947 there were 1976 mines of all kinds in India. The number of persons employed in these mines are given below :—

Employed in Mines in 1948.

	(000)
Coal	348
Salt	89
Mica	32
Gold	24
Manganese	20
Iron-ore	9
Petroleum	4
Total	539

The Government is now giving greater attention to the mining industry in India. A Bureau of Mines has been started to achieve greater progress.

QUESTIONS

1. Estimate the extent of India's iron-ore resources. What are the geographical drawbacks under which Indian iron-ore suffers at present ?

2. Where is the manganese ore mined in India ? What are the future prospects of manganese mining in India ?

3. What is the extent of mica resources in India ? Why mica mining on a decline at present ?

4. Where does India get its salt from ? To what extent is the salt production in India dependent on climate ?

5. What is the source of gold in India ? What are the difficulties which the gold mining has to face here ?

6. Suppose you have been appointed adviser to a big concern interested in manganese mining. In what parts of India should it start operations ? What other countries of the world are likely competitors against your Firm in the supply of manganese ? How do conditions of manganese mining and transports in India compare with those in foreign countries ?

CHAPTER IX

MANUFACTURES

India's economy centres round her agriculture which provides her people with food and the raw materials. Under ordinary circumstances Indians have been quite content to follow their forefather's occupation—agriculture. Even the rudimentary manufacturing that has existed in the country for long, has been associated primarily with agriculture.

The intimate contact with the English and the consequent growth of an urban population in India led to a rise in the standard of living of the people. Articles which were formerly considered luxuries became necessaries of life. The demand for manufactured articles thus grew considerably. A very large section of the urban population became entirely cut off from agriculture. The natural corollary of this separation from land was that, in due course of time, the city-dwellers started manufacturing enterprises on Western lines. The beginnings of industrial enterprise in India were started first by the Europeans, but were, later on, taken up by the Indians themselves. The first industrial magnates hailed from the two largest towns of India, Calcutta and Bombay, where the Western influences were most dominating.

Industrial activity in India spread from the port towns of Bombay and Calcutta, not only because of the Western influences, but also because of the ease with which machinery and stores could be imported from Europe through these ports. These towns were already large business centres, and as such, supplied banking facilities so necessary for industrial enterprise.

Another advantage enjoyed by these port towns for industrial enterprise was that most of the raw materials and other exports were accumulated there to be shipped

abroad. These facilities were fully taken advantage of by the new industrialists.

India is still backward in manufacturing industries. The development of 'key industries', like the Iron and Steel and the Chemical industries, the products of which are essential for the general industrial development has not advanced far in India. The main cause of this backwardness of the 'key industries' and the consequent backwardness of industries in general, is due largely to the defective distribution and poverty of coal resources of the country. Indian coal lies mostly in a remote corner of the Peninsula where means of communication are deficient. Compared with this, the coal resources of the United States of America and England and of Germany lie in well-developed regions. The water communication provided by the rivers serving the coal region there has been of fundamental importance in developing the coal. These communication facilities also helped in attracting manufacturing industries to it. The inferiority of the quality of the Indian coal has already been noted elsewhere in this book.

The most important manufacturing industries which have been developed in India, therefore, are such as do not require much coal or other fuel; as for example, cotton, jute, sugar and paper, etc. The machinery for these industries is imported from abroad where coal is abundant for machine industry.

The want of skilled labour is also one of the causes of the industrial backwardness of India, but that is a very minor defect which can be soon removed, provided other factors are favourable. Indians can learn an art as quickly and as well as any other people in the world.

Iron and Steel Industry

The iron and steel industry is the basic industry of the modern world. But the art of manufacturing iron was known in India at least one thousand years before Christ. The iron pillar at Delhi is a standing proof of

the quality of the iron produced in India in ancient times. The famous Demascus blades of the Saracens were made of the Indian material. In modern times, the first attempt at steel making in India was made by an I. C. S. officer, named Joshiah Heath. His scheme failed. It was the Barakar Iron Company, which later passed into the hands of the Bengal Iron Company, that first succeeded in this object.

But it was only when the Tata Iron and Steel Company took up this work that steel production was started in India. The original project of the Tata's was to make 120,000 tons of pig-iron and 70,000 tons of steel per year. The growth of the Tatas has, however, been remarkable and in 1949 the Company produced 917,000 tons of pig iron and 1,574,000 tons of steel ingots and finished steel. The Company's works at Jamshedpur are expanding to be able to produce much larger quantities of pig iron and steel. This increased production by the Tatas together with the production of the Steel Corporation of Bengal and of the Mysore Steel works is expected to meet the normal demand in India. The total production of steel in India in 1950 amounted to 15 lakh tons.

The most important factors in the development of the modern iron and steel industry are :—

(a) Raw materials, (b) fuel and (c) market. The other factors like communication, skilled labour and locational advantages are of minor importance.

While considering the development of the iron and steel industry in India, the first thing that strikes us is the lack of adequate market. The products of this industry are in demand mostly by industrialized urban societies. Machinery and tools for the factories, rails, wagons and cars for communications, steel girders and door frames for buildings, and thousand and one such things of steel are in demand by urban societies today. India is backward industrially. She has very few towns; she has

very few railways; she has very few cars. The natural result is that she has very little of iron and steel industry.

The other thing that strikes us is India's poverty in coal. Coal is the only important fuel that is used in the iron and steel industry today. Electric furnaces are in use in some countries like Sweden, Switzerland and the U. S. A. But their output is negligible; besides, they handle only a special type of iron-ore. India's lack of suitable coal for iron and steel manufacture is, therefore, her greatest drawback in developing this industry.

As good coal is indispensable for iron and steel manufacture, we notice that practically the whole of this industry in India is centred near the coalfields of Jharia. The supplies of iron ore are widespread over the Peninsula, but they are seldom utilized, as they are not easily accessible to coal.

But while India is poor in suitable coal and has little market for iron and steel goods, she has immense supplies of good quality iron-ore. It should be possible to take this ore to places where coal is easily available and smelt it. This ore can be taken to places on the coast where iron and steel works can be started with the help of imported coal. This is being done by Brazil, which is importing coal for the purpose from U. S. A. But the market for steel must be enlarged first. At one time the Government of India were thinking of starting a new steel works in Madhya Pradesh. The plan appears to have been given up.

In this connection the importance of Vizagapatam is considerable. Large quantities of good iron-ore, manganese, and limestone occur in its neighbourhood. The finished products can be supplied from there by sea to such markets as Calcutta, Madras and Bombay. The beginnings of a repair shop for ships at this place, therefore, augur well for the future.

The present iron-smelting centres in India can be divided into two classes :—

(1) The pig-iron and steel manufacturing centre; and
(2) The pig-iron manufacturing centres.

Steel manufacturing requires proportionately more iron-ore than coal, while pig-iron requires proportionately more coal than iron-ore. The Indian Tariff Board of 1924 calculated that for manufacturing 1 ton of pig-iron $1\frac{3}{4}$ ton of iron-ore and $1\frac{2}{3}$ tons of coking coal are required in India ; while for 1 ton of finished steel 2 tons of ore and $1\frac{5}{6}$ tons of coking coal are required.

The biggest iron and steel works in India, the Tata Iron and Steel Works at Jamshedpur, are, therefore, situated nearer to the iron-ore supplies than to coal supplies. The smelting works at Kulti, Burnpur and Dhanbad—producing mostly pig-iron—are situated, on the other hand, nearer to coal than iron-ore.

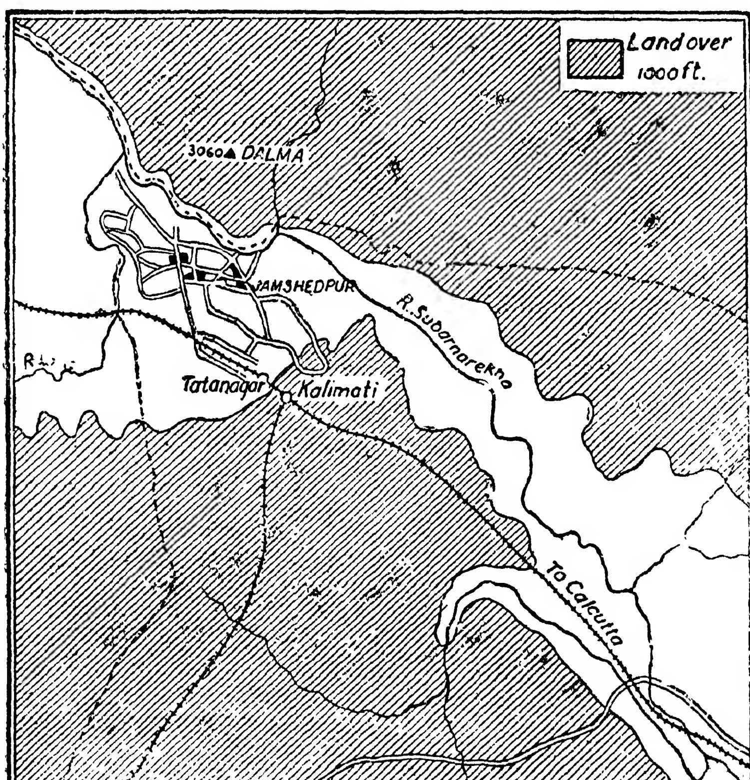

Fig. 49. Site of Jamshedpur.

The site of the Jamshedpur Works has been selected in a narrow valley formed by the Subarnarekha and the Khorkai (shown by R in Fig. 49) rivers in the district of Sighbhum in Bihar. The valley is only about three miles broad where the Works are situated between the two rivers. The sketch map shows that this is the only fairly extensive, flat and low-land area available in the vicinity of the hills that extend miles around. Iron works require large areas of flat land for their operation. This valley is, therefore, an advantage to the Jamshedpur Works. The hills to the south of this valley are the source of the coveted iron-ore deposits of Orissa. The main source of iron-ore supply of the Jamshedpur Works lies in these hills within 60 miles. The coal supplies come from the Jharia coalfield at an average distance of about 100 miles. The two rivers, the Subarnarekha and the Khorkai supply the Works with water. The water requirements in the iron works are very large. The presence of these rivers is, therefore, a great advantage enjoyed by Jamshedpur. These rivers are irregular in flow and almost dry up during summer. The water is, therefore, pumped from the Khorkai, which is nearer the Works, and stored in a tank. The Works are served by the main line of the B. N. Ry. joining the two most important towns of India—Bombay and Calcutta which provide the biggest markets for Tata's products. The iron-ore and coal supplies are brought to the Works by the branch lines of this railway.

The only important raw material which comes from longer distances is the flux (limestone or dolomite). Unfortunately, most of the larger occurrences of good limestone lie at distances above 200 miles from the Jamshedpur Works. The limestones found nearby are inferior, and irregular in quality of the material. Recently a large deposit of rich dolomite has been discovered near Sulai, a village situated a few miles from Dhatura station on the main line of the B. N. Railway near Jharsugudha in Orissa. A great importance attaches to this discovery in view of the easy communication both with Tatanagar and

Burnpur. The Jamshedpur Works first got their supply of limestone from Katni near Jubbulpore, but now they operate their own quarries at Pagposh, in Gangpur, which produces a dolomitic limestone which is inferior to the true limestone.

The other raw materials, manganese ore, fire clay and chemicals are required only in small quantities, and are available near at hand.

The Jamshedpur Works are situated in a region that is infertile and very thinly populated. The inhabitants of the region are the backward Santal tribes who do not care to work in factories. The labour force is, therefore, recruited from the densely populated valley of the Ganga mostly Bihar and U. P. The skilled labour is now mostly Indian and only partially foreign.

The Tata Iron and Steel Company has developed plans for the modernization and expansion of its Steel Works at Jamshedpur. The normal capacity of the plant at present is about 750,000 tons of finished steel per annum, and as it is proposed to increase this capacity to about 931,000 tons a year the programme is spread over a period of six years and involves a heavy capital expenditure.

Included in the programme is a scheme for installing a Skelp Mill to produce rolled strips, jute bands, cotton ties, etc. The major output from the Skelp plant would, however, be the skelp itself which is to be supplied to the proposed Tube Mill, which would manufacture welded tubes for gas, water and steam supplies.

Other items of interest are the establishment of an uptodate plant for the manufacture of refractories required by the steel industry and a plant for the utilization of blast furnace slag in the manufacture of light weight aggregate and hollow blocks. It is understood that the firebrick plant will meet most of the requirements of the Steel Works in the way of refractories and as the plant will be equipped with the most modern machinery for

efficient and large-scale production employing the latest labour-saving devices, it is expected that this new ancillary unit will be of very great help not only in reducing the cost of steel but would also make the Tata Iron and Steel Works rely on its own resources for this important raw material. The Steel Company has already vast resources of suitable raw materials for the firebrick plant.

Efficient utilization of industrial wastes, such as blast furnace slag has received considerable attention of the Steel Company. Economic utilization of the slag has been studied over a number of years and the proposal now made to manufacture light weight aggregate and hollow blocks would go a long way to ease the situation for the supply of a building material that is light, cheap and has better heat insulation properties.

The important pig-iron manufacturing centres of Kulti and Burnpur are situated on the coalfields. They are in a thickly populated area where the network of railways joins them to Calcutta which is the largest iron market in India. The exports of pig-iron manufactured by these centres also go VIA the port of Calcutta.

The iron works at Kulti, on the Barakar river, a tributary of the Damodar river, are the oldest existing iron works in India. The site of the works was originally chosen on account of the proximity of both coal and iron-ore. The out-crop of the iron-stone shales, between the coal-bearing BARAKAR and RANIGANJ rocks stretches east and west from the Works, and for many years the clay nodules of this iron-stone constituted the only supply of ore used at these Works. Now, the richer ore from the deposits in Kolhan has taken the place of iron-stone shales.

The coal supply is obtained from the Ramnagar Collieries only two miles from Kulti, and from the adjoining Collieries of Noonodih and Jitpur in the Jharia field. The limestone is obtained from Bisra (Gangpur), and also from Paraghat and Baraduar on the B. N. R.

The Burnpur Works are situated in the triangle made by the B. N. R. and the E. I. R. near Asansol. The works are only 132 miles away from Calcutta. The ore supplies come from Gua, in Kolhan. The B. N. Ry. have a branch line to Gua. Coal is obtained locally. Water supplies are obtained from a large reservoir on the works into which it is pumped from the Damodar river which is 2½ miles away.

Recently iron smelting has been started at Belur near Calcutta also.

A distant iron-smelting centre is far away in Mysore where no coal is found. Charcoal, therefore, makes up the shortage of coal. It is obtained from the rich forests of Mysore for smelting iron-ore. This is the only large centre in India using charcoal in place of coal. The works are located at Bhadravati on the Birur-Shimoga branch line of the Mysore State Railway, about 11 miles east of Shimoga. The site has been selected on the west bank of the river Bhadra where its valley widens to about 8 miles. Immediately in the neighbourhood are large reserves of forest. The raw materials are transported to the works by tramways and the Birur-Shimoga meter-gauge railway. The ore comes from Kemmangundi on the top of the Bababudan hills, about 26 miles south of Bhadravati. It was first proposed to bring the dolomite flux from Tumkur district but the cost of transport being heavy, the proposal was given up. Limestone is now used as flux and is obtained from Bhandigudda near Gangpur 13 miles east of Bhadravati. The Bababudan hill ores need mixing with siliceous ores. These ores are obtained from a quarry opened up near Birur. The wood required for making charcoal by distillation comes entirely from the jungle trees which cannot be made use of for any better purpose. The Bhadravati works are better situated in respect of ore and flux supplies than any other large iron-smelting centre in India. The ore used is, however, inferior.

Apart from the major production of pig-iron or steel in the iron works, the works, also produce a large quantity of chemical by-products from coke. Coal tar and ammonium sulphate are the important by-products in the works where coke is used for smelting, i.e., in Tatanagar and Kulti, etc., while lime acetate, wood-alcohol and wood-tar are the by-products at Bhadravati where charcoal is used.

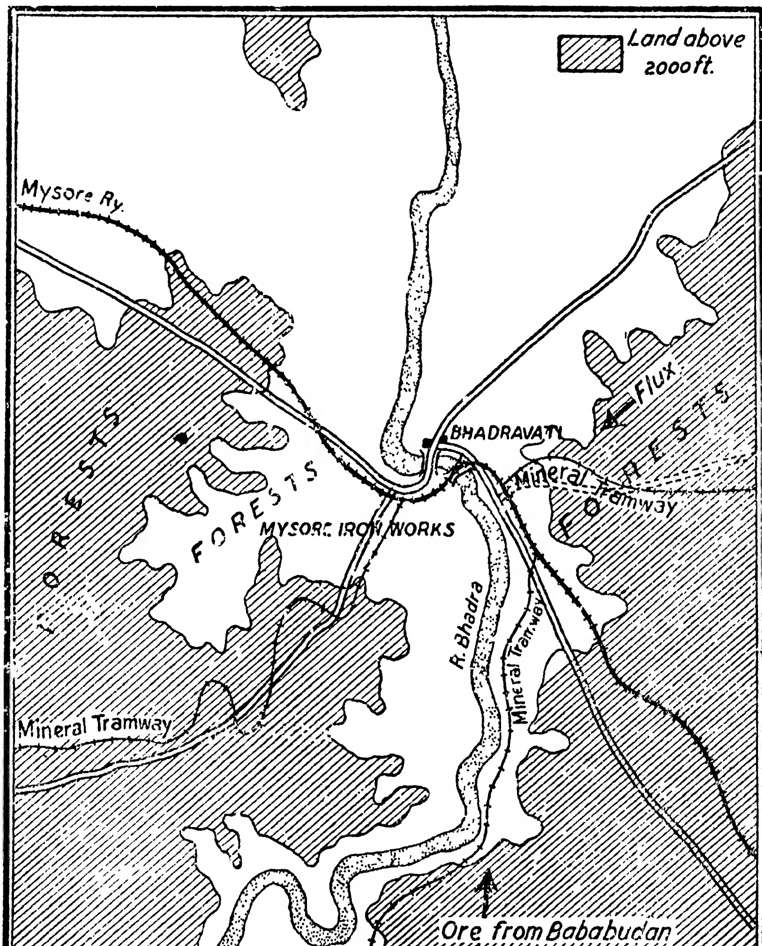

Fig. 50. Site of Bhadravati Works.

The manufacture of cement is another industry started recently at Bhadravati to make use of some of the by-products of the iron works, especially slag.

India's production of pig-iron or steel is insignificant when compared with that of the leading industrial countries of the world. It gives us some satisfaction, however, to know that we produced more than either Italy, Poland, Canada, Sweden, Austria or Hungary—all countries where, as in our case, agriculture is the dominant occupation.

Before the War, a large part of our pig-iron was exported to Japan and Great Britain.

Owing to the lack of market in India, our iron-smelting industry has become the source of exporting our iron-ore to foreign countries in the form of pig-iron. By this method, the foreign countries are able to get from India the metal without the impurities contained in the iron-ore. Iron-ore is a heavy and bulky material whose export to distant countries is not economical if exported as ore. If, however, it is exported as bricks of pig-iron, the cost of transport is negligible. England and America can thus purchase pig-iron from us and send it back to us as finished steel or machines at a much higher price.

Although the United States of America is one of the world's largest producers of pig-iron, she imports considerable quantities from India because of the unusual characteristic of Indian pig-iron which gives it special value in the manufacture of steel. Pig-iron is mixed with scrap steel in the open hearth furnaces to make steel. The more scrap steel which can be used with the pig-iron, the less expensive and more desirable will the resulting steel be. Indian pig-iron is a good scrap carrier, i. e., it makes possible the use of a greater amount of scrap, and because of this, American steel producers are willing to pay a higher price for Indian pig-iron than for American pig-iron.

This does not mean, of course, that the Indian pig-iron is at all indispensable, and although American imports of

Indian pig-iron amounted to about 3½ lakh dollars in value in 1939 (as compared with about 2 lakh dollars in 1938), any unfavourable developments in the price position would seriously affect the trade.

The following table gives some idea of the progress that the Indian iron and steel industry has made between and during the two World Wars :—

Pig and Steel Production in India

Year	(Lakh Tons) Pig-iron	Steel
1914	243	...
1923	455	134
1934	1495	...
1939	1575	977
1942	1800	1200

The following gives the Tata's Production :—

(000 Tons)

	1948	1949
Pig Iron	956	917
Steel Ingots	901	906
Finished Steel	663	668

COTTON INDUSTRY

The cotton textile industry is by far the most important manufacturing industry in India. This is shown by the fact that of the average daily number of workers employed by different manufacturing industries in India in 1947 more than 6 lakhs were employed in cotton mills. This was the largest number employed in any single

industry.* If to this is added the number of the raw

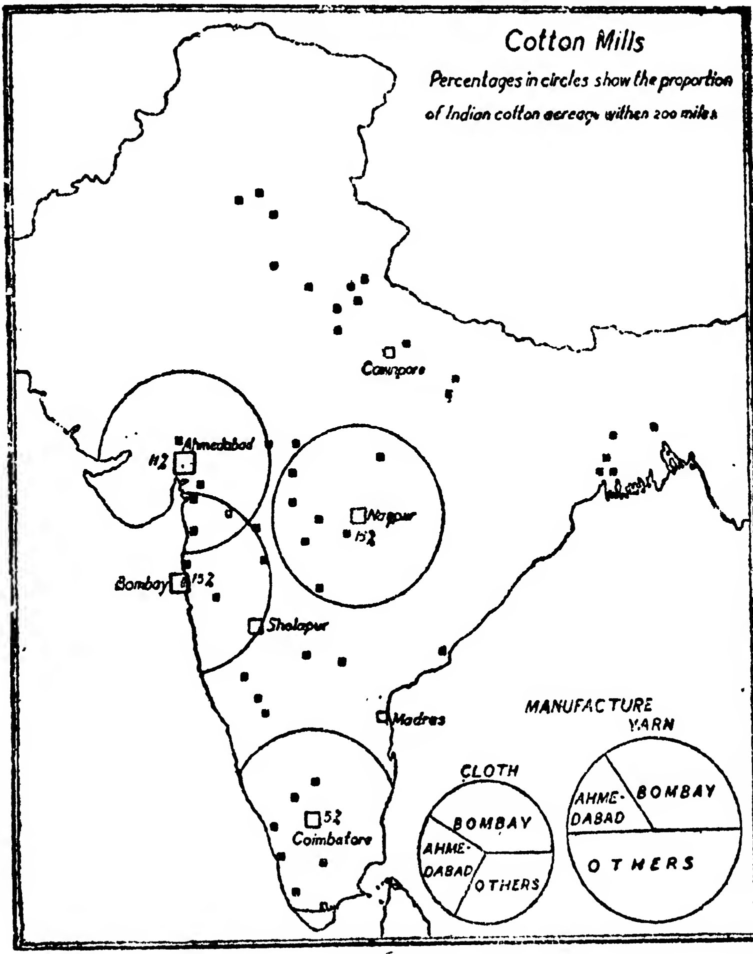

Fig. 51.

*Numbers Employed, 1947

		(000)
Cotton Textile Industry		600
Jute	,,	300
Sugar	,,	84
Iron and Steel	,,	69
Cement	,,	19
Paper	,,	17

cotton growers who supply the raw material to the cotton mills and whose number is estimated to be about 9 lakhs, the basic importance of the cotton industry to the well-being of the people can be easily gauged.

The Cotton Textile industry has the largest amount of capital invested in it. The following table compares the invested capital in some industries in India in 1948-49 :—

INVESTED CAPITAL

	Crore Rs.
Cotton Textile	171
Jute Industry	71
Iron Steel „	65
Sugar „	29
Cement „	15
Paper „	9

The localization of the cotton mill industry depends upon many factors, such as the supply of raw material, fuel, chemicals, machinery, labour communications and market. Any of these factors may determine the location of this industry, provided it gives a decided advantage in competing against other locations of this industry. Thus, Lancashire in England does not produce any raw cotton, nor does it enjoy locally any considerable market for the products of cotton mill industry. But it commanded through political control, a vast market in India. This one factor led to the tremendous development of the industry there. The ease with which the raw cotton can be imported from U. S. A., and the nearness to coal-mining areas, which supplied not only fuel and machinery but also cheap labour of women and children from the families of miners and workers in iron works, were all secondary advantages. Similarly, the access to the Indian and other neighbouring markets was an incentive to the development of this industry in Japan. Japan also does not produce

any raw cotton. It imported most of it from India. The vast supplies of cheap labour, and cheap ocean transport, together with Government support in various ways helped the development of cotton industry in Japan.

In India, the localization of the cotton mill industry has been brought about chiefly by the following factors :—

(a) Supply of raw material;
(b) ease of importing machinery and mill stores from abroad; and
(c) access to the market.

Supply of coal has not played any important part in locating cotton mills. For the amount of coal needed by the mills is negligible when compared with the vast amounts of raw cotton, finished goods or machinery that have to be moved. Climate also does not play any direct part. For artificial humidity supplied to the spinning rooms controls the moisture conditions of air quite efficiently without much cost.

In 1948-49 there were about 450 cotton mills with 183,000 looms and 92 lakh spindles. They produced more yarn than cloth. Part of the yarn made in the mills is supplied to handloom weavers in the country. In 1947-48 the amount of yarn produced was 133 crore lbs. and cloth 90 crore lbs. About half the yarn produced was coarse, of 1 to 20 counts. The cloth produced was also mostly coarse. This was due to the coarse cotton used. In recent years fine cotton from U. S. A., and Egypt had to be imported to run the mills. Most of the produce in 1950 was, therefore, fine and superfine.

The greatest advantage possessed by the Indian cotton industry is the extent of the home market. The significance of this advantage can be realised from the fact that for the two countries from which India drew practically the whole of the imports of manufactured cotton, i. e., Great Britain and Japan, she represented the largest single export market. An idea of the enormous extent of the Indian market can be gathered from the fact that, although imports into India in 1931 did not represent in

quantity more than 15 p. c. of the total consumption of cloth in the country they represented for each of the above two countries the largest single line of export.

The largest centres of cotton industry in India are where raw cotton is abundant. Bombay obtains the raw material from stocks brought to Bombay for export, as practically all the raw cotton is exported through it. It has also the advantage of importing machinery and mill stores from abroad easily.

Bombay and Ahmedabad are the principal centres of the industry; about one-half of the total number of mills in the country are at these two places, which together produced about half of the yarn and about two-thirds of the cloth manufactured by the Indian mills in 1931. The data for the two greatest centres, the towns of Bombay and Ahmedabad, are as follows :—

	Mills	Spindles (Lakh)	Looms (000)
Bombay City	126	29	67
Ahmedabad	79	19	47

Elsewhere in the country, the cotton mills are scattered wherever facilities of raw material are available. In the cotton mill industry, market and the raw material play the most important part. The following table gives the distribution of cotton textile industry in 1947-48 :—

State	Mills	Looms (000)	Spindles (Lakh)	Produce Yarn (crore lbs)	Produce cloth (crore lbs)
Bombay	281	126	55	66	52
Madras	71	12	15	17	3
U. P.	—	—	—	11	6
West Bengal	23	8	4	4	3
M. P.	10	6	3	5	2

As is characteristic of the regions where the raw material is abundant, production of yarn exceeds that of cloth in India. Most of the yarn spun is coarse, mostly below 30 counts. In 1931-32, 88 p. c. of the yarn spun in India consisted of counts 1 to 30s; and only 3 p. c. of

counts above 40s. This is due to the short and coarse staple of the raw cotton produced in India. Even the so-called long-staple cotton in India, taking warp and weft yarn together, is suitable only for the manufacture of yarn of counts 24s. to 40s. for all the long-staple cottons in India do not have the required degree of evenness and strength. The Punjab-American crop represents the largest proportion of long staple cotton in India, but about four-fifth of this is sold by the cultivator mixed with Deshi cotton. For the production of yarn of higher counts than 40s. no suitable raw cotton is available in India.

Finer yarn is spun in Ahmedabad and Bombay from cotton imported from Egypt and the United States of America.

India is now almost self-sufficient in matters of cotton manufactures. In 1935-36 only the Mill Production, leaving out the output of a large cottage industry, compared with imports is as follows:—

	Yarn	Cloth
Home Production	1095 Mil. lbs.	4259 Mil. yds.
Import „	48 „ „	974 „ „

During the War, there was a considerable increase in production, e.g., the production of cloth rose to about 4,800 milllon yards in 1943-44. But owing to shortage of coal the production could not be raised further. The tendency for declining production is noticeable, however, from the following table:—

Cotton Mill Production (Millions)

			Yarn (lbs)	Cloth. (yds.)
1947	...	...	1295	3762
1948	...	...	1447	4319
1949	...	...	1359	3904
1950	...	...	1174	3365

The export market for our cotton industry is very small. Our chief markets are the countries where the

Indians have settled in large numbers. The most valuable markets are South and East Africa, Iraq, Persia and Ceylon. Bombay does the largest export trade.

There is a great future for this industry in India as the standard of living is rising. At present the average consumption of cotton cloth in India works out at about 12 yards per head. This is very low when compared with 64 yards which is the average for U. S. A. To raise the consumption of cloth to any decent figure in India will require a tremendous growth of the industry.

But this development is handicapped for want of machine industries and heavy chemicals in the country.

The problem of raw cotton supply is a new problem which faces this industry due to the partition of the country. The amount of raw cotton produced in the Indian Union is not enough for the home needs. Raw cotton has, therefore, to be imported from Pakistan and other countries. The following table shows the consumption of raw cotton in Indian Mills :—

Cotton Consumption, (Lakh Bales).

	1948–49	1949–50	1950–51
Home Produce	31	23	30
Pakistani Cotton	4	2	...
Egyptian and other	7	8	6
Total ...	42	34	36

Cotton Handloom Industry

The cotton handloom industry is the oldest form of industry in India. It supplies today a considerable proportion of the cotton goods required in the country. About one-fourth of the supply of cloth in India comes from the handlooms. About 1400 million yards of cloth are turned out by the handloom industry in India every year. The handloom industry is widespread all over India, especially in old towns where skilled labour has come down from olden times. The yarn needed by the industry is supplied mostly by the mills. It is only weaving that is

generally done in these small towns. In some cases, however, yarn used is also handspun. Cotton is distributed to women-folk in the surrounding villages where it is spun and then brought to the town to be woven.

With the improvement of the handloom in recent times, the quality of the goods produced on the looms has considerably improved. Such improved quality goods enter successfully into competition with mill products, and give employment to thousands of workers. Some of the most important centres for the cotton handloom industry in India are Nagpur, Banaras, Gorakhpur, Tanda, Etawah, Dacca, Poona, Madura, Calicut, Ludhiana and Amritsar.

Jute Industry

Next in importance to cotton is the jute industry of India. More than 3 lakh persons find work in the jute mills annually in India. Unlike cotton, however, it is highly localized on the river Hooghly near Calcutta. The main cause of this is the concentration of the cultivation of jute in north-east Bengal and Pakistan. Jute mills are situated on the Hooghly both above and below Calcutta. Raw jute is transported to these mills either by the river or by road. The manufactured jute is easily shipped by boats to Calcutta by the mills. The supply of coal is also easily available.

Unlike cotton industry the jute industry of India is essentially an export industry. The market for jute manufactures in India is limited as the export of commodities needing jute packing is insignificant in comparison with the export trade of countries where jute packing is much in demand, e. g., U. S. A. Jute manufactures consist of canvas, gunny bags and gunny cloth.

The most important manufactures of jute mills are gunny bags, gunny cloth, rope and twines and canvas. The total manufactured goods of jute amounted to one and a quarter million tons in 1941-42.

Among the various problems facing the jute industry in India is its dependence upon raw jute from E. Pakistan.

Attempts are bring made to produce more raw jute in Bengal, Orissa and Travancore to be free from this dependence.

As the foreign trade or the inland trade of the world increases the demand for jute products for packing also increases. Many countries in the world, therefore, attempt to grow some substitutes for jute. In North America Kraft paper bags and cloth have been used for this purpose. But no fibre satisfies the double requirement of cheapness and strength that the jute fibre possesses.

The geographical distribution of the Jute Mill industry is as follows:—

Jute Industry 1949

	No. of Mills	Looms Hessian	Sacking	Total %	Total of all looms
West Bengal	95	43,208	22,220	95	69,125
Madras ...	4	287	755	1	1,042
Bihar ...	1	89	837	1	926
U. P. ...	3	302	519	1	821
Orissa ...	2	42	178	...	220
	105	$\underbrace{\qquad\qquad}_{68,416}$			72,338

World Distribution of Jute Looms

		World %	World's total.
India ...	68416	57	
Germany ...	9600	8	
Great Britain ...	8500	7	
France ...	7000	6	
Italy ...	5000	4	
Belgium ...	3000	2·5	120,000

One such substitute is the sisal grown in East Africa and other parts of the world. It is thought that the quality of the sisal has been considerably improved recently to make it suitable for producing bags. A feature of the recent growth of industrialism in South America is the attention which the various Governments are giving to the use of indigenous fibres for manufacturing purposes. In view of the large variety of fibre plants which are to be found in South America what is happening there is but natural. Brazil and Ecuador are well placed for the expansion of industries concerned with sack and bag making. In Brazil, special attention is being given to the possibilities of CAROA, which is indigenous to the country. Its leaves reach a length of from 5 to 6 feet, each plant having three or four usable leaves which produce on an average 25 grammes of dry fibre. The distribution of the caroa plant in Brazil is very extensive. It is abundant in the valley of the River San Francisco and in the sandy portion of Pernambuco, Ceara and Bahia. It is claimed that this Brazilian fibre is better than Indian jute for bag making. The points emphasized in favour of caroa are that it is naturally white, that there is no necessity for it to be carded and emulationed before being spun and that the longer the spindle the better. It is also claimed that the strength of caroa is sixty times that of jute.

The jute industry of India has profited much from wars in the past. Thus, the Crimean War and the American Civil War brought prosperity and opportunities for expansion, while the two Great Wars created an unprecedented demand in this industry. The trench warfare which prevailed in the wars needed millions of bags. In the second World War also, there was a large demand for sand bags for A. R. P. work. The second World War, however, used fewer bags than the first World War.

The following table shows the mill consumption and production in recent years :—

MILL CONSUMPTION OF RAW JUTE AND PRODUCTION

Year	[Lakh Bales] Bales	Production Lakh Tons
1942	67	12
1943	56	10
1944	58	9
1948	24	10
1949	28	9

WOOLLEN INDUSTRY

The Woollen Industry in India is not an important one. The hot climate of the country over the greater part stands in the way of a large demand for woollen goods. The home supply of raw wool is also very inadequate. The few woollen mills* that exist in India work mostly imported raw material and cater for the needs of the towns mainly. Kanpur, Ahmedabad, Ludhiana, Bombay, and Bangalore are the important centres of this industry. Kanpur has the distinction of having the largest woollen mile (Lalimli) in Asia. The mill production of woollen goods in recent years is given below :—

WOOLLEN MANUFACTURES

	(Lakh lbs).
1948	200
1949	210
1950	180

Apart from the mill production, there is a certain amount of production from the handloom industry as well. This industry is located mostly in the hills, Kashmir (Srinagar) and Kumayun (Almora) are the main regions.

*Woollen Mills, 1948.

No.	Looms	Spindles
26	1,527	70,303

Sugar Industry

India is the second largest producer of sugar in the whole world,* accounting for about a fifth of the total canesugar production of the world. It consumes practically all the sugar that it produces. Its huge population thus offers the greatest market for sugar in the world. This industry employs about 82,000 people every year in the factories.

The sugar industry in India is a new industry, which shows what the Government can do to aid in the industrialisation of the country. Like cotton, the sugar industry has the advantage of a vast home market. The Indian Tariff Board on Sugar Industry in 1931 estimated the extent of the market to be Rs. 60 crores per year. This market is increasing with the increasing habit of tea drinking and a rise in the standard of living in other ways. The most important factor that attracts sugar factories is the abundance of raw material within short distance. In northern India, the cultivation of sugarcane is sufficiently concentrated in small areas where factories can be located. Unlike other important industries, sugar industry requires very little outside fuel. The bagasse, or the waste material after the juice has been extracted from the cane, is burnt in the factories to run the machinery. In a large number of factories wood fuel is used to supplement the bagasse. Wood is generally plentiful in rural areas, particularly in the north, where the submontane Terai jungles supply abundant fuel. The water requirements of the factories are met with either by sinking tube wells or from irrigation canals. Sugar factories do not require much water. Rural areas supply cheap unskilled labour, while the skilled labour is not difficult to get. Concentrated supply of cane is thus the basis of the localization of sugar industry.

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*Sugar production in 1948-49 :—

Cuba	5,763,000	Tons.
Indian Rep.	5,580,000	„

The largest number of mills are in the submontane districts of the Gangetic Valley. The most important provinces are the U. P. and Bihar which between them have about 75 p. c. of the total number of sugar factories in India These two states together accounted for more than 81% of the total production of sugar in India in 1937-38. Bombay, Madras, Punjab and Bengal are the other producers of sugar in India.

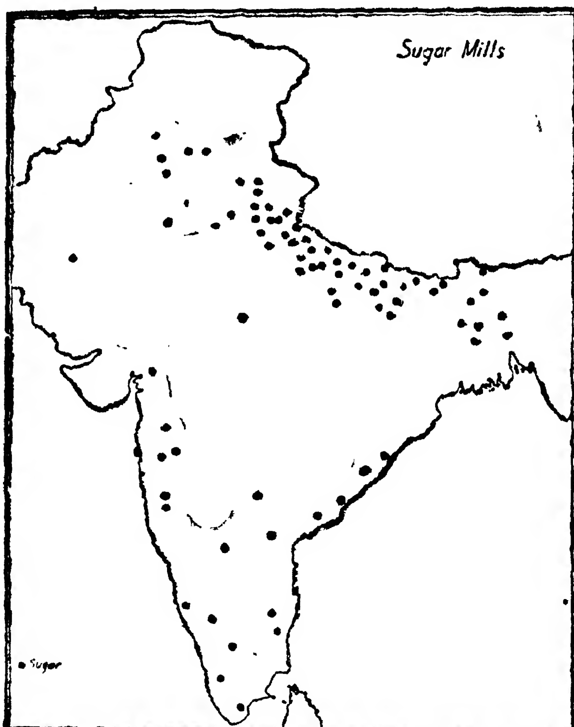

Fig. 52

On account of the peculiarity of the climate in northern India, which limits the supply of cane to the factories only to a few months, from about November to March, the sugar factories have to remain idle for the greater part of the year. Even during this short crushing season, some factories are unable to get enough cane.

There is a tendency on the part of the factories, therefore, to acquire land near their sites for cultivating sugarcane on modern line. This is an effort to copy Java and Cuba, etc.

In Southern India crushing period is a longer one, as the hot, dry and SCORCHING summer of the Indo-Gangetic plains is not felt there.

Most of the cane juice is water and is evaporated or drained off as molasses when sugar crystals are made from it. The total amount of sugar obtained from the cane is only about one-tenth of the weight of the cane. In Java and other tropical islands this is slightly more than in India, owing largely to the efficiency of the sugar mills.

A survey of the sugar industry in India, in the light of the protection granted, is interesting. We shall survey both the manufacturing and agricultural aspects over a number of years. In 1917-18 the area under cane in India was approximately three million acres. It fluctuated round this figure during the next fifteen years. It was not until 1933-34 that there was a noticeable increase in acreage, coinciding with the policy of protection introduced. Within the next four years the acreage figure exceeded four millions, and continued in the neighbourhood of this figure until the War. Over three million acres of this are under improved quality cane yielding as much as 15½ tons, in comparison to about 12½ tons per acre in 1930-31. It is clear that from the agricultural point of view the policy of protection given to the Indian Sugar Industry has done considerable good to the country. The cost of production of sugar in India, however, is high when compared with Java or other tropical areas where the cane yield is higher. The most outstanding feature of the sugar industry in India is the SHORT crushing season due to the hot, dry summers over the cane area.

The effect of protection to sugar industry was marked in the number of new mills. The very first year of

protection witnessed a doubling of the number of factories operating in the country.

This unprecedented increase, however, created certain difficulties for the industry. Over-production and uneconomic internal competition became marked. In 1934, therefore, an Excise Duty was imposed which slowed down the erection of new factories in favour of the extension of plant in existing factories.

SUGAR MILLS AND PRODUCTION

Year	No. of factories crushing cane	Cane crushed Lakh Tons	Sugar produced Lakh Tons	Recovery of sugar %
1947-48	134	109	10 7	9·8
1948-49	134	100	10	9·9

The sugar production in India increased at such a rate that in 1937-38 the net imports of sugar had fallen away to the comparatively insignificant figure of 22,000 tons—essentially of special qualities of sugar not manufactured by Indian factories—against a total consumption of approximately 1,200,000 tons. The sale price of sugar also came down from about Rs. 9/6 per maund to about Rs. 6/9 per maund.

In this connection it is interesting to note that the PER HEAD consumption of refined sugar in India is only 6·7 lbs. This means that there is a large potential market for sugar in this country. Other points to be remembered are :—

1. The Indian factories crush only 22 per cent of the total cane grown in India; the remaining cane is used for making gur.
2. The production costs here are high, about Rs. 6/14 per maund;
3. The retail price of sugar in India was before the War 19 pies per lb., as against 11 pies

per lb. in Cuba and 13 pies per lb. in Java which are the other two most important sugar-producing countries of the world.

A large proportion of the cane grown in India is used for the wasteful method of manufacturing GUR. In 1942-43, the total amount of gur manufactured in India was about 56 lakh tons as compared to about 10 lakh tons of sugar produced by factories crushing cane for direct manufacture of sugar. In 1947-48 only 35 lakh tons of gur was made. This is because a considerable demand exists for gur in the villages in India. The largest amount of gur is manufactured and consumed in U. P. The cost of gur is also the cheapest in U. P. owing to the cheap wages. The per capita consumption of gur in India is as follows :—

U. P.	40 lbs.
Punjab	36 „
Bombay	18 „
Bengal	15 „
Bihar	10 „

Some of this gur is also used by the KHANDSARIS for manufacturing a kind of brown sugar. In 1948-49 about 75,000 tons of such sugar was made.

The manufacture of sugar either from the gur or directly from the cane yields a liquid which is called the 'molasses'. This is considered to be a waste product.*

The use of molasses for power alcohol has been receiving the attention in India for some time past. This power alcohol can be added with petrol and can thus relieve considerably the shortage of motor fuel, apart from proving a source of income to the sugar manufacturer. In 1950 the production of alcohol in India was as follows :—

*Supply of Molasses

U. P	63 Lakh Mds.
Bihar	15 „
Bombay	10 „
Madras	7 „
Mysore	4 „

	(000 Bulk Gallons)
Power alcohol	4500
Rectified spirit	3400

The production of power alcohol from molasses has made considerable progress in recent years, as the Government now compels the mixing of alcohol with petrol for sale in the proportion of 1 alcohol to 4 petrol. The following table shows the increase of power alcohol production :—

Years	1947	1948	1949	1950
Lakh Gal.	27	37	42	45

There are now 15 power alcohol distilleries in India, and 4 more are being erected. They are all connected with sugar mills. The largest number is in U. P. The distilleries at Sardarnagar and Captainganj in U. P. are the largest (with capacities of 14 and 12 lakh gal. respectively.) The Government proposes to raise the total capacity of the distilleries to 23 million gallons by 1955. In our country where the petrol resources are negligible, power alcohol is of great importance.

U. P. has the largest supply of molasses in the whole country, and naturally, therefore, has the largest scope for developing the power alcohol industry. The number of power-distilleries is given below :—

	Existing	Proposed
U. P.	11	1
Bihar	1	1
Hyderabad	1	...
Mysore	1	...
Bombay	...	1
Pepsu	...	1

Among other uses to which molasses may be put may be mentioned the following :—

(i) as cattle fodder ;
(ii) for building road surfaces mixed with asphalt or bitumin ;
(iii) as manure, either directly or in composts.

The supply of molasses has grown with the growth of sugar production in India. It has increased from 69,000 tons in 1931-32 to 425,000 tons in 1940-41. This supply of molasses is in addition to the molasses produced by KHANDASARIS and GUR refineries.

The following table gives the production. in various states in 1948-49.

PRODUCTION OF SUGAR FROM CANE

	000 Tons	% Sugar recovery	No. of Factories
U. P.	527	9·9	65
Bihar	184	10·3	29
Bombay	88	10·8	10
Madras	51	9·3	9
Indian total	1,000	9·9	134

PAPER INDUSTRY

The Paper Industry in India employs annually about 18,000 people. In 1948 there were 24 paper mills in the Indian Republic. The production in different parts of the country was as follows :—

	000 Tons
West Bengal	44
Orissa	15
U. P.	10
Bombay	8
Travancore	4
Mysore	3
Hyderabad	3

Unlike the sugar and the cotton industries, the paper industry of India is handicapped for want of a large home

market. Owing to the backward state of education in the country, the consumption of paper in India is very little. This is unfortunate, because India has a large supply of raw material necessary for a prosperous paper industry. Most of this material has, however fallen to the share of Pakistan. The 'Sabai' or the 'Bhabar grass' is the staple material for paper making in India. It closely resembles

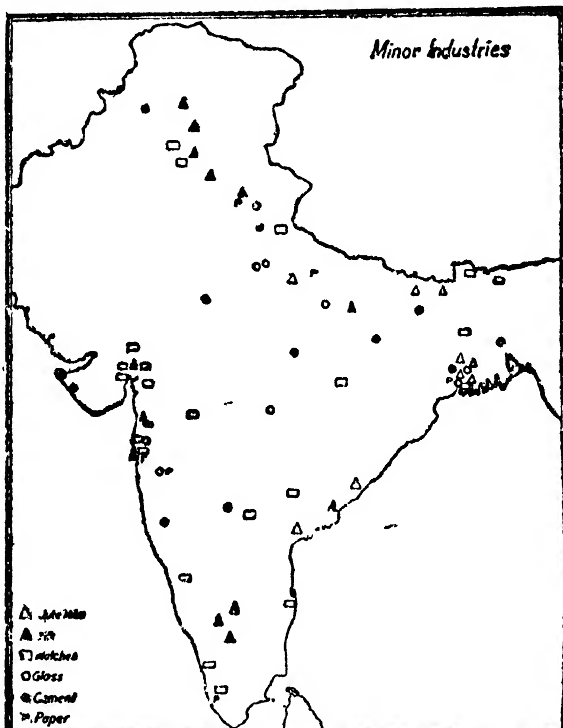

Fig 53.

the Esparto grass of Africa which is so much in demand by the British paper industry. The greatest drawbacks of the Sabai grass are that it grows in tufts intermixed with other vegetation and it is difficult to separate impurities from it. The supplies are also limited. The supplies of bamboo, the other raw material of paper industry in India, are almost inexhaustible because of its quick and dense

growth. The regeneration of wood-pulp forests takes about sixty years, while the bamboo forest is ready in a year or two. The quality of paper produced from the bamboo, however, lacks in strength. But the bamboo has an advantage over the Sabai in that the paper can be made entirely from bamboo without any admixture of wood-pulp. But the paper made from bamboo lacks the bulking quality of Sabai grass paper and cannot so easily be used both for printing and for writing. On the other hand, both in finish and clearness of surface of writing it is greatly superior to grass paper, and does not compare unfavourably with the imported paper. India does not produce paper from wood, either because suitable wood does not grow in India, or it grows in inaccessible areas in the Himalayas.

Most of the paper in India is produced in the neighbourhood of Calcutta which, with its large population, large number of presses and offices, offers the largest market for paper. Good quality paper is manufactured from imported wood pulp. Wood-pulp is also mixed with grass pulp to produce suitable paper. The advantages enjoyed by the Bengal Mills are that they are very near coal supplies, large market and plenty of water from the Ganga. They have, however, to get the raw material from long distances.

The Indian production of paper and paper board is insignificant when compared with some of the other producers. In 1935, India produced only about 49 thousand metric tons of paper as compared with

9,1	Lakh tons in	U. S. A.
2,9	Lakh tons in	Canada
2,7	„ „	Germany
5	„ „	Finland
4	„ „	Norway

In 1935-36, India imported more than three times the home production of paper of all kinds. The largest item in the imports was that of printing paper, which alone was valued at about a crore of rupees.

The effect of protection afforded by the Government to the paper industry in India has been good. This can be seen from the fact that whereas in 1931-32 there were 8 paper mills producing about 40 thousand tons out of the total consumption of about 82 thousand tons in India, roughly about one-half, in 1936-37 there were 9 mills. Their production was about 48 thousand tons out of the total of 113 thousand tons consumed in India, less than half. The important point to note, however, is that before this latter year the Indian mills imported from abroad more than 53 per cent of the raw material they used, while in this year they used only 23 per cent imported raw material. The rest of the raw material used in Indian mills was indigenous pulp. The increase in production of 8 thousand tons over 1931-32 was all of paper in the protected class, whereas the increase in imported paper was confined to unprotected classes. Of significance is the development in the use of indigenous pulp, and principally bamboo pulp, which increased from 5 thousand tons to 19 thousand tons over the same period. Grass pulp and other pulps, however, have increased only slightly.

In 1948-49 about 1 lakh tons of paper of all kinds were imported at a cost of about 12 crores of rupees. The home production was also about 1 lakh tons. In 1950 the record production of 108,000 tons was made. At the end of the proposed Five-Year Plan the capacity of the mills is to be raised to 175,000 tons from the present 135,000 tons.

For newspapers, in which mechanical paper is used, India is entirely dependent on imports. The Paper Pulp Section of the Forest Research Institute, Dehra Dun, is experimenting in this line. It has found certain varieties of fir and spruce suitable for newsprint production. The Madhya Pradesh Government has started the NEPA Mills in which it is proposed to manufacture newsprint. When this factory goes into production, it is expected to supply 30,000 tons of newsprint per year.

MATCH INDUSTRY

Match industry in India employs annually about 12,000 people. No country in the world can be said to be self-sufficient in all, or even most, of the raw materials of the match industry. Labour* accounts for the largest share of the cost of production of matches. India, with its teeming millions is, therefore, in a favourable position as regards the match industry. It has the advantage, not only of cheap labour, but also of a vast home market. The chief disadvantage is in respect of wood. Suitable wood grows in India scattered here and there, or in insufficient quantities. Most of the Indian wood used comes from Andamans or the Sunderbans. Match-wood logs must be obtained with the bark unremoved so that the wood may not dry. They may also be cylindrical and for this reason occupy more space. The cost of transport is, therefore, necessarily high.

Wood cannot be extracted from the Indian forests during the Monsoons. Heavy stocks must, therefore, be stored by the factories. The stocks are attacked by the borers in the store and cause much loss. Large quantities of aspen wood are imported from abroad, especially Finland and Russia, in Bombay where suitable Indian wood is not easy to get.

The largest production of matches is in the neighbourhood of Calcutta where Indian wood is mostly used. The Indian wood in use in Calcutta is GENWA, though PAPITA and DHUP from the Andamans are also used ; DIDU and BAKOTA also come from the Andamans. GENWA is available in large quantities in the Sunderbans. The next important centre for the industry is Bombay where the wood is imported. But there are some factories in Gujarat and

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*The Indian Tariff Board Report, 1928, gives the most important items of cost of producing one gross as follows :—

Labour 5 annas, wood 3 annas ; chemicals 1 anna ; others 5 annas. Most impottant chemicals used are Chlorate, Potash, Paraffin and Amorphus. Sulphur is a very minor item.

other parts of Bombay where Indian woods are used. These woods are SIMUL, mango and SALAI. These woods do not grow in large quantities at one place. Plantations of SIMUL have now been undertaken by some factories. SIMUL is very good for box-wood, but is inferior for sticks. In fact, there is no Indian wood, except perhaps the mango, which is as good for splints as the imported aspen.

The total amount of matches produced in India in 1950 was about 5 lakh cases, each containing 50 gross boxes. The production is increasing under the protection of Government. The imports of matches have now practically ceased. The Swedish Match Industry which was the greatest supplier of matches to India has built its own factories here and imports most of the raw material from Sweden or Finland.

Glass Industry

Glass making on modern lines is of very recent origin in India. It was only during the first World War that the real progress in this industry was made. Glass industry employs today about 21,000 people annually. There is a considerable home market and some of the raw materials are easily available. By far the most important raw material is the silica sand.

Sands of a degree of purity requisite for glass making are found at several places in India. At Mangal-Hat and Patraghatta, in the Rajmahal hills, there occur white Damudas and stones, which after crushing, washing and sieving, yield sand from which ordinary quality glass can be made. From Lohagra and Bargarh near Allahabad a suitable sand is obtained by crushing and grading a Vindhyan quartzite. Good quality sand can be obtained from sandstone at Sankheda and from the Sabarmati river sand at Pedhamli, both near Baroda. Sands of suitable quality also occur at Jubbulpore. The sands found at Bargarh and Lohagra are used by most of the factories. In addition, sands from Jejon Doaba in the Hoshiarpur dis-

trict and from Sawai Madhopur in Jaipur State are also used by some factories. Suitable sand also occurs in Mysore State.

Among the chemicals used, the Soda ash is exclusively imported. Refractory materials for the furnaces and coal for firing the furnaces are available in India. A cheap supply of coal is of a great importance. The choice of the raw materials for glass making is a matter of great importance, as the quality of the finished product depends very largely on the purity of the material used. Suitable major raw materials are available in India, but the important consideration is the location of the factory, so that these materials may be brought together cheaply.

In addition to the manufacture of glass by modern methods, there is also the indigenous glass industry for making bangles from the inferior varieties of glass. This glass is manufactured from the impure sands of the rivers and the efflorescent alkali salts of the REH, commonly found in many parts of India.

The glass-making industry is localized in the Ganga Basin where coal, saltpetre and skilled labour are easily available. The network of railways helps in the assembling of the raw materials. Out of the 55 glass factories working in India in 1935, there were 47 in this Basin alone. Most of these factories are in U. P. where Firozabad is the biggest centre.

U. P. is the most important both for the factory and the cottage glass industry in India. Out of the total annual production of glass goods in India, valued at Rs. 1·2 crores, the U. P. accounts for about Re. 1 crore. There are in U. P. 8 hollow-ware factories, 47 bangle factories, 2 bottle factories and 2 sheet glass factories.

The production of Glass and Glassware in 1950 in India was as follows :—

	(000 Tons)
Hollow-ware	86
Sheet glass	5
Bangles	16

Cement Industry

The manufacture of cement also is of recent development in India. The increasing home market due to increased activity in building trades and new uses of concrete has led to considerable expansion. The excellent quality of the Indian product has overcome the initial prejudice against a new thing, and the industry is now firmly established.

Cement is usually produced by the action of intense heat on a finely powdered mixture of limestone or marl with clay or shale. The mixture should contain about three-fourths of calcium carbonote and about one-fourth of clay material, with a little gypsum. In India some of the limestones contain all the ingredients in almost correct proportions. At Banmore (Gwalior Portland Cement Co.) the limestone so nearly contains the necessary things that very little clay has to be added. At Lakheri (Bundi Portland Cement Co.) no clay at all is used, the correct proportion being obtained by mixing different grades of limestone. In other cases substantial amounts of clay have to be added. The proportion of gypsum necessary is about 5 per cent.

Abundant supplies of limestone of excellent quality exist in many parts of the country close to the railway, so that the cement factories have usually been established near the quarries. Suitable clay is invariably found close to the factory. Gypsum is produced in India but has to be brought from long distances at high cost of transport. Counter-balancing these natural advantages, almost all the cement factories are situated at such a distance from the coalfields that the freight on coal is very high. Inferior local coal may in some cases be used for damage to the machinery, but the coal used in the kiln must contain low percentage of ash. At least half of the coal used in the factories, therefore, must be from the Bengal and Bihar coalfields.

With the exception of the works in Kathiawar and Madras, none of them are within short distances of the

seaports. This gives them an advantage so far as the inland markets are concerned, as they are in a better position to compete against imported cement. In the ports themselves, however, which being the largest towns, are great markets for cement. The Indian cement had to face severe competition in the beginning. An import duty is, therefore, levied on imported cement.

More than four-fifths of the home demand is supplied by Indian factories whose output is increasing every year. The imports are declining every year. From 125,988 tons in 1928-29 they came down gradually to 55,936 tons in 1935-36. The Indian production in 1935-36 was about 9 lakh tons. In 1942 there were, however, 20 cement factories in India with a total capacity of 28 lakh tons. In 1936 Indian production (9·8 lakh tons) was about one-eighth of the total world production. The Indian production rose to 26 lakh tons in 1950. The present installed capacity of the factories is about 31 lakh tons annually which is more than the present requirements of the country.

CEMENT PRODUCTION, 1940

(000 Tons)

U. S. A.	22
Germany	16 (in 1938)
United Kingdom	8 (Do.)
France	4 (Do.)
Italy	4 (Do.)

To see the location of the minor industries, reference may be made to the map on p. 256.

ALUMINIUM INDUSTRY

The aluminium industry, a war-born industry, has made spectacular developments during the past few years, and India has now a prominent place among the world producers of aluminium. It is the only nonferrous metal of which, so far as is known, India possesses large deposits. Rapid developments are taking place in the manufacture and utilisation of this metal.

The year 1943 saw aluminium produced for the first time in India at the Alupuram (Travancore state) Reduction Works of the Indian Aluminium Company. Since then, spectacular developments have taken place. The whole of the war-time requirements were supplied by the Indian Aluminium Company. The rolling mills in Belur, near Calcutta, and the manufacturing plants produced sheet metal and components for aircraft parts, radio and field telephone equipment, range finders, field hospital equipment, etc. From a technical point of view, production operations in the Travancore factory compare favourably with the large production units in Canada and the United States of America. Carbon electrodes required for aluminium reduction are produced in the Works. Arrangements are complete for the production of strong alloys of the duralumin type. The Travancore factory will produce, when its power requirements are fully satisfied, 5,000 tons of aluminium. The construction of the Aluminium Works for the treatment of Indian bauxite at Muri (Bihar) is nearing completion. This factory will have an ultimate capacity of 40,000 tons per annum. The Aluminium Corporation of India, Asansol, has now started working and produces at present about 1,000 tons of aluminium a year. This production will be stepped up shortly.

The total production of aluminium in India in 1950 was about 3½ thousand tons.

Paint Industry

The paint industry is another important chemical industry in India. This industry had its beginnings here as far back as 1902, when the first commercial factory was established at Goabaria, near Calcutta, and for several years after, this pioneer factory continued to be the only producer and did much valuable research work in establishing the fact that the Indian products could compete favourably with imported articles of paint. With the outbreak of the Great War of 1914, not only were imports restricted but there was a considerable increase in the

demand for paint products. As a result of this situation there are today about a dozen factories manufacturing paints and varnishes, etc.

The paint industry in India has been assisted to no small extent by the fact that we produced in our country many of the essential raw materials in paint manufacture, e. g., linseed oil, turpentine, red and white lead, red oxides, ochres and barium sulphate.

The real development of the industry, however, dates back to a very recent date. It is only since 1937-38 that the imports of paints and their products have decidedly declined. Simultaneous with this, the Indian products have shown a steady rise. But even now the imports of paints and painters' materials account for considerable import into the country. The following table shows the quantity of paints manufactured in India :—

	1937-38	1938-39	1939-40
	(In Thousand Cwts.)		
Dry Colours	96	131	148
Paste Paints	218	197	246
Mixed	151	155	164
Enamels	9	11	18
Varnishes	42	39	48

The progress of Indian chemical industry must play a very important part in the broadening of India's economy. The manufacture of heavy chemicals is not advanced in India, even though some of the raw materials of this industry are found here. The manufacture of acids, alkalis and their salts forms the background of heavy chemical industry. India is poor in sulphur which is the basic component of the heavy chemical industry. At present all sulphur needed by us is being imported either from Sicily, Japan or from U. S. A. To replace totally or even partially this imported sulphur, India can only fall back upon the scanty deposits of pyrites near Simla. Still more inaccessible deposits in Assam and comparatively good deposits of gypsum in Madhya Bharat are also available.

The other source, not of any considerable magnitude, is in the recovery of sulphur oxide produced in the roasting of copper ores near Ghatsila which produces about 7,000 tons per year. Another source that is tackled even in highly industrialised countries abroad is coal. But our coals are poor in sulphur, except the deposit of a tertiary nature in Assam, where the organic sulphur content is very high.

The impetus given by the war has resulted in considerable progress in heavy chemical industry in India. The production of soda ash, chlorine and bleaching powder has now begun here. A factory for bleaching powder at Rishra, and for soda ash at Port Okha have been started. Sulphuric acid is manufactured at various places, specially at the Tata Works in Jamshedpur, Digboi Oil Company Works in Assam, and at the Mysore Chemical and Fertilizer Works.

Heavy Chemicals

India is backward in the production of heavy chemicals. One of the reasons for this backwardness is the lack of suitable raw materials in required quantities. India does not possess industrial salts, sulphur, or copper in any considerable amount. Without heavy chemicals, however, not only is the general industrialization of the country impossible, but the artificial manures necessary for increasing the yields of agricultural crops cannot be obtained. The ammunition for our armies is also supplied by heavy chemicals. The starting of the heavy chemical industry was, therefore, considered essential for the progress of the country.

In 1943, the Foodgrains Policy Committee of the Government of India advised that, in future, India would require two to three million tons of nitrogeneous fertilizers, costing about 70 crores of rupees per annum. It recommended immediate action to establish a factory for nitrogenous fertilizers. Realising the importance of this industry as a defence potential, the War Resources Committee resolved at the end of 1943 that the Government

should undertake the responsibility for such a factory as a nationalized industry. During the next few months steps taken to start the artificial fertilizer industry either at Harduaganj near Aligarh or at Sindri near Dhanbad in Bihar. Ultimately, Sindri was preferred, as it has the advantage of water supply facility of getting the raw material, and its situation near the coal mines. The two most important requirements of the fertilizer industry are the supplies of gypsum as the raw material, and plenty of water. Gypsum was expected from the Salt Range of West Pakistan. As a large amount of coal was being sent to the Punjab, considerable number of wagons were returning empty to the coal mines. The cost of transport of gypsum supplies to Sindri was, therefore, expected to be low. Due to the partition, however, the Salt Range gypsum could not be depended upon. Luckily, large amounts of gypsum occur near Bikaner and Jodhpur. These are being developed and about 1 lakh tons have already been stockpiled at Sindri. The main difficulty is the transhipment at Agra where the railway gauge changes to the metre gauge. When in full operation, the Sindri Fertilizer Factory would require about 2,000 tons of gypsum every day.

The water requirements of the factory are estimated to be large, about 12 million gallons per day. These will be supplied from :—

(i) An artificial lake built by a dam on the Gowai river which is a tributary of the Damodar joining it about four miles upstream from Sindri;

(ii) An Infiltration Gallery to tap the water available in the sands in the bed of the Damodar when the surface flow diminishes; and

(iii) The Pumping and Purification Works on the Damodar river.

The factory itself can be divided into four main groups, namely, (1) Power House (ii) Gas to plant (iii)

Ammonia Synthesis Plant and (iv) Sulphate Plant Storage. The power house contains the complete plant for generating power for the factory and for supply of process steam. Of this group the power-house, which comprises 6 boilers each capable of producing 175,000 lbs. of steam per hour at high pressure, 6 turbines with a total rated capacity of 80,000 kw. with all its associated coal handling, ash handling electrical switching, cooling water arrangements, etc., is almost finished. The power-house will supply not only power and steam for process work necessary for the operation of the factory, but will also export power to the D. V. C. grid, for the much-needed expansion of coal mining, and for industrial development generally in the Damodar Valley area, including the big Chittaranjan Locomotive workshop at Mihijam near Asansol.

The gas plant with its 8 large generators designed to produce 33 million cu. ft. gas per day, with all its associated coke-handling arrangements, gas purification plant, and gas storage, holders is complete. Coke for the operation of the gas plant has been stockpiled to the extent of 100,000 tons. Even this large stock of coke represents only 170 days' consumption in the factory.

The constructional work of the factory is expected to be complete in 1951, and the first quantity of usable ammonium sulphate would be produced shortly thereafter. Production at the full installed capacity, namely, 1,000 tons per day, will, it is anticipated, be reached by March, 1952.

Besides yielding 3½ lakh tons of ammonium sulphate, whose estimated requirements for India were calculated to be at least 15 lakh tons for the four years beginning from 1948-49 involving an expenditure of Rs. 71.57 crores the Sindri Fertiliser plant would have an additional national importance as the basis of a heavy chemical industry of our country.

Another fertilizer factory is being projected for Mysore also.

There are a number of smaller works where different kinds of heavy chemicals are manufactured, specially with

imported raw material. Travancore, Calcutta, Kanpur, and Asansol are among the most important places for this production.

The production of heavy chemicals in 1950 in India was as follows :—

	(000 Tons)
Sulphuric acid	102
Soda ash	44
Caustic soda	11
Superphosphates	52
Ammonium sulphate	47
Liquid Chlorine	4
Bleaching Powder	3
Bichromites	2

The great demand for KHAKI cloth for soldiers during the war has led to a considerable production of bichromates of soda and potash. Madras, Mysore, Bombay, Kanpur and Calcutta have factories for these.

Tobacco Industry

The value of Indian tobacco production comes to 37 crores of rupees. This includes both, manufactured tobacco,—cigarettes, cigar, cheroots, bidis and snuffs—as well as some other semi-manufactured forms of Hookah tobaccos.

The industry got its impetus during a period of 15 years—from 1920-35. There has been a general increase of the number of tobacco factories since 1923. During the year 1935, 22 registered cigarette factories employed 8,000 persons daily.

Over half of the cigarette leaf produced in India is purchased by Indian Leaf Tobacco Development Company for export and sale to the manufacturers in the country. About ¾ of the output of cigarettes in India is handled by four Indian factories. These factories are located at Bangalore, Saharanpur, Monghyr and Calcutta.

Between 22-23 million lbs. of tobacco leaf is used for the manufacture of cigarettes. About 15% of this is

imported from the United States. Annual production of cigarettes is 7,500 millions and its value being nearly 6 crores of rupees. Leaves undergo a complex process of grading, blending, flavouring and moistening before being ready for manufacture. Fast running machines, and skilled workers are required in order to make satisfactory cigarettes. The cigarette paper is properly printed by the same machine. Care is taken for sealing and scientific packings by using transparent papers to make them moisture proof.

CIGAR. Madras specialises in cigar manufacture, which is different from cheroot in shape. The quality of leaf used for cigars, as well as the value of ready product, is much less than of the cigarettes. Cigar manufacture is simpler than the cigarette manufacture and may be done by an elaborate machine. The quality of the cigar depends on the leaf which is wrapped on it. The filler leaves used are of Trichinopoly origin and occasionally also from Guntur. The process of cigar manufacture consists of rolling, pasting the tip ends and heating at 150° to 160° of temperature to ensure its safety from insects.

CHEROOTS. Madras is the main cheroot manufacturer. The average annual output of cheroots in India is estimated at 90-92 million lbs. or 18,500 million cheroots valued at over 9 crores of rupees. Thus it is more important than the cigarette manufacture.

Cheroot making is practised as a cottage industry. Rolling of cheroot and management of business is always done by woman labour. The quality depends on the coloured leaf wrappers, filler leaf and flavour. The Madras cheroots are large, thin and dark-coloured.

Bidi is a cheap smoke. Bidi manufacture extends both in Northern as well as Southern India. Its importance is both as an indigenous as well as commercialised industry. Over 75,000 million bidis are annually manufactured in India using about 70 million lbs. of tobacco. The total manufacture is estimated at 7·5 crores of rupees.

The manufacture of Bidis is more popular in the Deccan than in Northern India. Almost all the large towns in India are large centres of bidi industry. Poona is considered as pioneer of bidi manufacture in South India. Bhandara district in M. P. has special advantages for bidi industry. Cheap and plentiful supply of wrapper leaf and labour have given vitality to the industry there. Jubbulpore, Gondia, Nagpur and Kamptee are the leading and controlling centres of industry. It is a flourishing industry in Madhya Pradesh and gives employment to over 42,000 persons. Bhandara district alone employs about 31,000 people.

Cheap tobacco with mixtures is used for bidi filling, thus making it cheap. The Deccan forests abound in the wrapper leaves, which are obtained at a very low price. The process of bidi making is simple. The wrapper leaves are first moistened to facilitate folding. Moistening of leaves is done at night to begin with the work during day time. Drying of the packets is the final process under artificial heat. Packing is done on contracts for the sake of economy in production.

Hookah Tobacco. It is an important smoke for Northern India. All towns and villages manufacture hookah tobacco. Delhi, Lucknow, Rampur and Gorakhpur are the chief centres. Annual output comes to about 6 million lbs.

There are two types of hookah tobacco; one is karuwa and the other 'mitha'. Cured tobacco plant is dried and powdered. This powder is mixed with the jelly obtained from semi-used molasses. The kinds of 'karuwa' or 'mitha' are made according to the proportion of mixture and various ingredients to give smelling and taste. Preparation of 'khameera' takes a longer time to be useful. Manufacturers use adulterants for making it cheap.

Chewing Tobacco. Zarda, Qiwami or Danedar are the chief chewing tobaccos in the market. Delhi, Lucknow and Banaras are the most important places of manufacture.

The leaves are boiled in lime water and then dried and scented. Chewing tobacco is also used raw by the villagers. Over 156 million lbs. of chewing tobacco leaf valued at a little over 3 crores of rupees is annually consumed in the country.

THE SNUFFS. The manufacture of snuffs also extends all over India. The annual average production in India is estimated at 21 million lbs. valued at about a crore and a half of rupees.

The following table gives an idea of the importance of the tobacco industry in India :—

Kind	Amount of tobacco used	Number	Value
Cigarettes	... 23 million lbs.	7,500 millions	6 crores
Cigars	... 1/2 " "	33 "	1/7 "
Cheroots	... 92 " "	18,500 "	9 "
Bidis	... 70 " "	75,000 "	7·5 "
Hookah tobaceo	... 6 " "		9·6 "
Chewing tobacco	... 156 " "		3 "

INDUSTRIALIZATION OF INDIA

Large-scale industrial development in India, specially that of the 'key industries' cannot progress far without considerable Government help. The main item in such a help is one of Protective Duties levied on imports of manufactured articles. These duties tend to raise the prices of manufactured articles to the consumer. There has, therefore, been a good deal of controversy within recent years for and against industrialization in India.

The main arguments AGAINST industrialization are :—

1. Industrialization of India will cut off imports because they consist of manufactured articles. This will automatically result in the reduction of our export trade, as the imports and the exports tend to balance each other. Foreign countries will not buy our goods because we do not buy theirs.

2. Industrialization lays a burden on the Indian consumer who is usually the poor Indian cultivator and who also loses the foreign market for his produce. This burden consists in the higher prices and the heavier taxation, which naturally result from the protective policy.

The main arguments FOR industrialization are :—

1. Industrialization increases employment in the country all round. Labourers get more work, railways and transport agencies handle more goods, and the Government gets more revenue from taxation. For the effect of industrialization is to increase incomes generally.

2. Industrialisation provides an alternative source of employment to the people, and an alternative source of revenue to the Government, whenever the main occupation of the country, i. e., agriculture suffers.

3. It is not correct to presume that if protection had not been granted to a particular industry, the consumer would have obtained the goods in question from foreign countries at a lower price. On the contrary, it is obvious that the establishment of indigenous industries tends to bring down prices, as has been the case in cotton textiles and sugar in the past.

4. India's exportable commodities are of a monopoly or semi-monopoly character and hence the foreign countries must come to us for buying them. There is, therefore, no danger of our cultivator losing the market for his produce.

5. Industrialization is not likely to stop India's import trade; although it might change its character and composition. The very process of industrialization is bound to release the large potential purchasing power of the people and also increase production, both industrial and agricultural, thus encouraging both the import and the export trade.

INDUSTRIAL REGIONS OF INDIA

India is industrially a backward country, yet there are certain areas which show, owing to the concentration

of certain manufacturing industries, all the characteristics of industrial regions. These characteristics may be said to be :—

(i) Large urban population ;
(ii) Large banking facilities ;
(iii) Integration of some main industry around which group a number of subsidiary industries ;
(iv) A network of communication lines ; and
(v) A large market for labour.

Bearing these facts in mind, it cannot be said that every town or centre where some sort of manufacturing is done should be described as an 'industrial region.' This term should be reserved only for those areas which possess all the characteristics listed above. The underlying idea is that in an 'industrial region' a particular industry and the occupations depending directly upon it form the major source of the income of the people there. This criterion naturally leaves out from our discussion a large number of isolated places in India where manufacturing industries, depending upon some local geographical advantage, are carried on. Such, for example, are the places where a solitary cotton-ginning factory or solitary cotton mill may be working or where there may be a small glass factory or a cement or lime factory.

The following are, therefore, the main industrial regions in India :

1. Calcutta.
2. Bombay.
3. Coimbatore.
4. Madras.
5. Tatanagar.
6. Ahmedabad.
7. Kanpur.

Calcutta is the most important industrial region in India. A great variety of industries is carried on in Calcutta, but the main industries are jute, paper, iron

and cotton. These industries are located mainly outside the congested town of Calcutta. Howrah, Lillooah, Belur, Dum Dum and Budge Budge are some of the important suburbs of Calcutta where these industries are carried on. The industrial sites have been selected mostly along the banks of the river Hooghly which serves as an important line of communication with the town and port of Calcutta, besides the railways that serve Calcutta. An important feature which distinguishes the Calcutta industrial region from the Bombay industrial region is the quarters provided for the labourers near the factory itself. The long distance that ordinarily separates the factory from the Calcutta town makes this necessary; while the large areas of open land near the factories make the building of labour quarters possible. In Bombay, on the other hand, the mills are generally situated within the town in congested areas. The CHAWLS (the houses where the mill workers live in Bombay) are, therefore, part of the town.

The geographical factors which have led to the rise of industries near Calcutta may be summed up as follows:—

(a) SITUATION AT THE HEAD OF THE ESTUARY AND THE VALLEY OF THE GANGA. On the one hand, this enables an easy contact with the sea facilitating the imports of machinery and the export of finished goods; and on the other, it gives an access to the interior of the country through the various railways and roads connecting Calcutta with the coalfields, the sources of raw material, the sources of labour supply, and the chief markets which require the articles manufactured at Calcutta.

(b) NEARNESS TO COAL. Most of the coal produced in India is within easy reach of Calcutta. There is no other manufacturing region in India which is situated so near the coalfields as Calcutta. Coal is used in Calcutta industries for generating steam with which the machines are driven, and also for generating electricity which is used in the factories for numerous purposes.

(c) NEARNESS TO RAW MATERIAL. Raw jute, the basis of the most important jute mill industry of Calcutta is found near at hand. The raw materials for other industries like the paper, leather, iron, chemical and textile industries can also be obtained from nearby places easily.

(d) LABOUR SUPPLY. The dense population of the Ganga Valley is a vast source of cheap labour for Calcutta. Several places near Calcutta, like Murshidabad and Dacca, have been famous in the past for the skill of their textile workers. It is true that the modern factory today has no use for that type of skilled labour. But it cannot be denied that the old textile industries of Murshidabad and Dacca had brought into existence a group of workers who, because of their life-long work in textile industries, were able to pick up the new technique of manufacture quickly.

(e) MARKET. The vast population of the Ganga offers an immense market for things produced in this industrial region.

(f) ECONOMIC ADVANTAGES. The early start of banking facilities, the development of railways, the settlement of Europeans at an early date in Calcutta, were some of the economic advantages that helped the rise of industries in this region.

Except jute, which depends on foreign markets for its prosperity, all other industries carried on in Calcutta cater for the home market.

Bombay is an important industrial centre of India, its importance lies chiefly in the fact that the only truly 'Indian' industry, the cotton mill industry, in which the capital and the organisation are both Indian, is centred at Bombay.

Bombay is, however, a small island with hilly area at its back. This limits the area of level land where factories can be erected. It is also far away removed from the coal-producing regions of India. Its advantage

is in the fact that it is a port having a vast foreign and coasting trade. It can, therefore, import cheaply by sea whatever it needs. It has also good rail connections with the interior.

A unique feature of Bombay is that in the neighbourhood of Bombay lies the most important hydro-electricity-generating region in India. Bombay now, therefore, depends largely on this hydro-electricity for its industrial development.

The most important industries carried on in Bombay are the textile engineering and chemical industries.

In Bombay State outside the town of Bombay, the various industrial centres like Ahmedabad, and Sholapur are all important for the manufacture of cotton goods, owing to the proximity of raw cotton.

Among the difficulties which have tended in the past to restrict the development on a large scale of industries in Madras are the high price and scarcity of fuel, owing to the fact that nowhere south of the Hyderabad State has coal been found to exist in workable deposits. The hydro-electric and thermo-electric projects which have been completed or are under construction or contemplation will, however, go far to remedy the deficiency and admit of the exploitation of the natural resources of the State to the maximum possible extent. The extent of development of electricity will be realised when it is mentioned that during the last decade the number of units generated has increased from 20 million to 170 million units. Already, the possibility of establishing several important industries not thought of years ago, has been opened up by the advent of cheap electric power over a wide area of Madras, while the existing industries have been benefiting thereby in an increasing measure.

Among the existing industries, the important manufactures are textiles, sugar, matches, cement and soap. The number of cotton mills increased from 21 in 1927 to 49 in 1937, and the total number of factories of all descrip-

tions increased from 1301 to 1564. Chemicals, steel rolling, silk and tobacco are other rising industries.

The industrial importance of some of the various states in India, based on the average daily number of workers employed by different industries is given below:—

State	No. of Workers
1. Bengal	531,235
2. Bombay	425,784
3. Madras	223,976
4. U. P.	147,502

Cottage Industry

The large-scale manufacture described above is a feature of town economy which is of recent growth, and still limited in extent. Village economy is still the dominant form in India. Cottage industry is a special feature of village economy all over the world. Unlike the large-scale industry, cottage industry is not localised to any great extent. It is widespread all over the country. Different castes in India took up in the past different industries, and therefore, the geographical distribution of cottage industries in India is generally according to the distribution of castes. The necessary skill for carrying on the craft was handed down from father to son, or from the master to the apprentice. The raw material is usually available near at hand; while the tools needed are very few and simple and in most cases are manufactured locally. The power needed is mostly hand power. The largest section of the cottage industry thrives on the local market. The organisation of the industry is generally mediæval, though efforts are now being made to reorganise it on modern lines, especially with a view to offer better opportunities to the more skilled and artistic cottage workers. The cottage worker usually combines agriculture with handicraft which he carries on only during his periods of leisure from agricultural work.

Cottage industries are widespread all over the country, but certain centres have acquired great reputation for their wares than the rest. Such a reputation depends either on the quality of the raw material available at a particular centre, or the skill of its workers. There are certain towns in India where the cottage workers at one time received the patronage of the kings or the ruling chiefs. These workers studied the tastes of their rulers and produced especially artistic articles which became famous all over the country. At the present time the disappearance of the patronage and the rise of the factory system turning out cheap articles have caused a decline of the cottage industries, especially interest in Art.

The largest cottage industry in India is the handloom weaving. There is no part of India where it is not important, but Assam, Bengal and Madras are more important than the rest of the country. The less developed the railway transport in any part, the more developed is the handloom industry. Assam,* having the least facilities in railway transport, has the largest number of handlooms in India (4¼ lakh looms)†. The cottage weavers now purchase the yarn from the cotton mills.

Formerly, spinning and weaving were both done at home. Within recent years, under political propaganda. Home spinning has considerably revived. The All India Spinners' Association did useful work in this line.

Handloom weavers' societies have increased in number in India. In Madras alone there were 123 weavers' societies in 1939. New designs are being introduced, and small-scale factories providing new opportunities for employment have been set up under the centrally financed scheme for the development of the handloom weaving

*There is a custom in Assam under which every bride has to present the groom with a piece of cloth woven by herself for making the nuptial dress.

†The Indian Tariff Board Report, 1932.

industry. In 1939, the sales of weavers' societies in some of the provinces were as follows:—

	Rs.
U. P.	500,000
Bengal	150,000
Bombay	100,000

The new designs introduced in some of the provinces were as follows:

Punjab	800
Madras	300
Bengal	150
U. P.	141
Bombay	95
Bihar	46

Bihar produced 100 different classes of staple goods ranging from the ordinary MOTIA and marking cloth to mosquito net of leno and quilts of toileting weave which are required for either personal wear or house-furnishing. In Bombay 40 new patterns were introduced in shirting. In U. P. new styles of SARIS woven with the printed yarn and new varieties of mercerized and cellular fabrics were introduced.

Among other cottage industries may be mentioned metal work, leather, wood-engraving, oil-crushing, and pottery. These are carried on in different parts of the country.

A cottage industry that has its importance for export market is the carpet weaving industry. Carpets are made from fine wool imported from Kashmir or abroad, and sent out to America or Europe. The products being expensive, they are very little in demand in a poor country like India. The most important centres producing carpets are in the Punjab, Kashmir and in U. P. (near Mirzapur). The industry is on the decline, owing to the competition from machine-made carpets which are much cheaper.

Leather Industry

Leather industry is an important industry in India. There are two branches of the industry, the factory industry and the cottage industry. The factory industry is

located in certain towns where there are many skilled workers and where the supply of raw materials is adequate. This latter depends upon the facilities of transport. The cottage industry of leather is spread all over the country and deals mainly with the local raw material. Vegetable tanning and chrome tanning are the two methods of preparing the leather in India.

The leather factories in India are concentrated mainly at Madras, Agra, and Kanpur. In 1950, there were 25 large tanneries in India. The total produce of leather and leather goods is given below :—

	1948	1949	1950
Vegetable Tanned Hides (crore)	196	183	151
Chrome Tanned Hides (crore)	108	58	49
Footwear (Pairs) (crore)	320	285	283

Our leather industry is now mainly dependent upon the supply of raw skins from Pakistan. The home supply is not enough. As the supply from Pakistan has been irregular the output has declined recently.

QUESTIONS

1. Compare and contrast the cotton industries of India and Japan.

2. Discuss from the geographical point of view the recent development of the sugar industry in India.

3. Why is the Indian cotton not so popular in Lancashire as in Japan? Discuss the factors that retard the popularization in India of cotton that can find a market in Lancashire.

4. Assign geographical causes for the existence of a very large number of sugar factories in U. P.

5. What major industries can be best developed in India? Discuss.

6. Under what geographical conditions is the steel industry carried on in Tatanager ?

7. Discuss the causes of the present backwardness of industrialisation in India.

8. Discuss the geographical factors underlying the development of iron and steel industry in India.

9. What is the importance of Cotton Textile Industry in Indian Economy ? What geographical factor led to this importance ?

10. Discuss the importance of the following Indian industries giving geographical causes :—

Paper, Matches, Cement and Glass.

11. What is the geographical background of the Cottage Industry in India ? Why are most of the cotton industries in India on the decline ?

12. Give the arguments for and against industrialization of India.

CHAPTER X

COMMUNICATIONS

India is a vast country with a huge population, and yet the lines of communications are not as well developed here as they are in some of the countries of the West. The backward state of our commercial development is its main cause. Until recently Indian economy has been

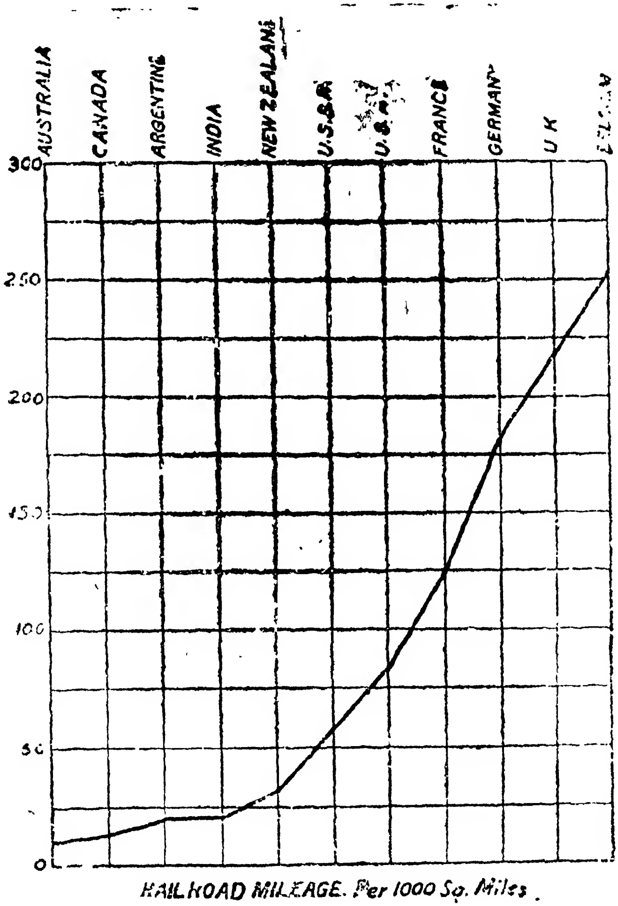
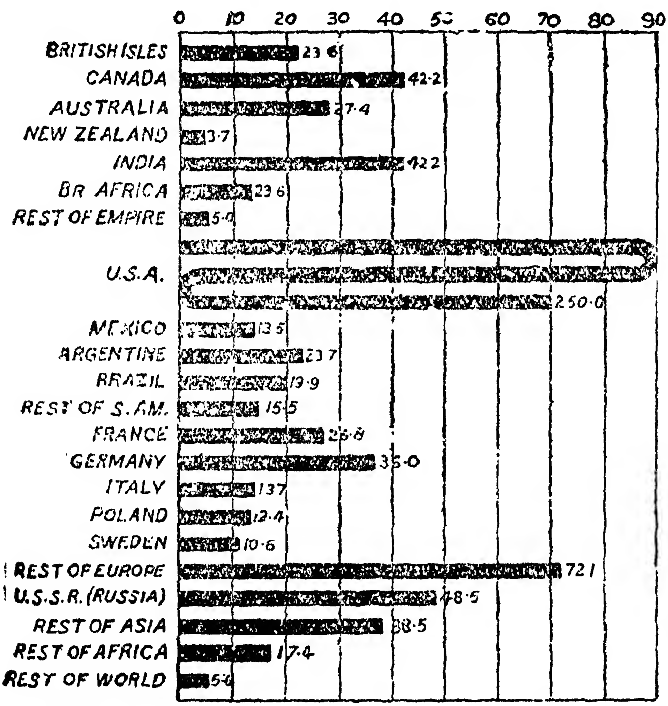


Fig. 54.

characterised, more or less, by self-sufficiency in which transport played very little part. The development of communications in India is a feature of the modern times when her contact with the West brought about the development of a foreign commerce in which, unlike the commerce of the ancient times which was marked by light and precious goods, heavy goods predominate. Unlike the old foreign commerce which followed the land route, this foreign commerce in heavy goods passed through seaports which had, therefore, to be connected with the inland centres by modern means of communications.



WORLD RAILWAYS. Length of lines operated in miles (Thousands omitted)

Fig. 55.

The most important of the sea-ports on which the foreign commerce of the country concentrated, later became important industrial centres which necessitated

a further development of communications between these ports and the inland towns, for their market as well as the source of raw material lay in the hinterland. The main feature of the communications in India is that they especially join the sea-ports to their hinterland, there being a marked absence of large industrial and commercial centres inland.

From many points of view, the railway is the most important means of transport in India. There are about 33,000 route miles of railways open for traffic in India. This gives less than 25 route miles for every thousand square miles of area. The above diagrams show that this average is very small when compared with some of the countries of Western Europe which are essentially industrial, but when compared with the essentially agricultural countries, the position is not so hopeless.

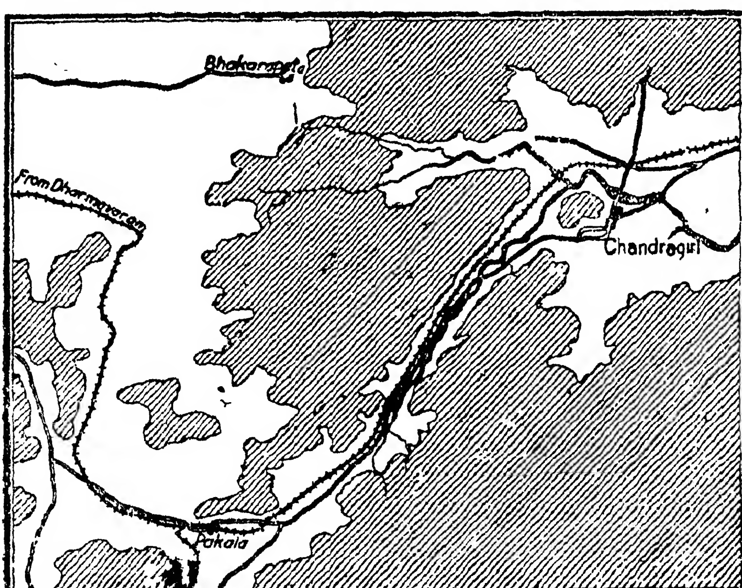


Fig. 56.

Of the total route mileage roughly about one-half is in the Indo-Gangetic Valley which, with its fertile

plains and large population together with Calcutta, one of the biggest Indian sea-ports, naturally offers the most favourable conditions for railway development. Before partition at one time this Valley possessed the longest Indian railway (the N. W. R. 6,900 miles), the busiest Indian Railway (the E. I. R. earning about 17 crores of rupees annually), and the most profitable Indian Railway (the Shahdara Light Ry. yielding about 10%, on an average between 1926-27 and 1935-37 and the B. & N.W.R. yielding about 9% for the same period).

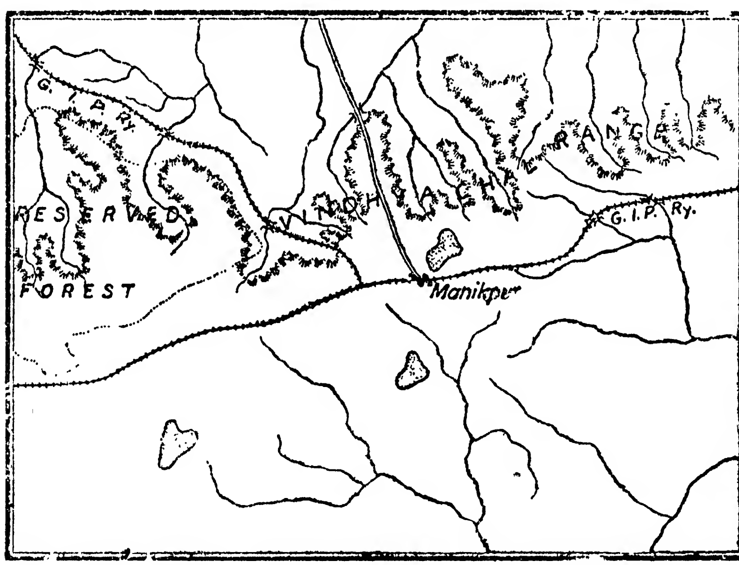


Fig. 57.

The general characteristic of the route in this valley is that it is straight over long distances. The absence of hills enables the railway line to run for miles without changing its course. But while the level nature of the valley helps the railway, the heavy rainfall and the numerous streams necessitating costly bridges are a drawback. The frequent floods also raise the cost of maintaining the track. The ballast for the railway track is available from the hills adjoining the Indo-Gangetic Valley.

The railway lines in the Gangetic Valley are characterised by a large number of branch lines. The branches are particularly numerous in areas where the traffic is spread over the adjoining area. The best examples of such areas are the Raniganj and Jharia coalfields. There is no other part of India where the network of railways is so dense as in these two areas. The network of railways is denser in the Indo-Gangetic Valley than in the Peninsular India. The railway lines of the Indo-Gangetic Valley terminate at Calcutta while towards the north the Himalayas are a natural barrier to further extension. It is only near Darjeeling and Simla that the mountain railways have penetrated the outer ranges of the Himalayas.

The railway lines running in the Peninsular India are zig-zag as compared with the almost straight lines in the Indo-Gangetic Valley. The broken topography of the south compels the lines to change their course and gradient from place to place. The gradients are here much steeper than in the level plains of the Indo-Gangetic Valley. These steep gradients necessitate the services of a 'banking' engine at some places; as for example, near Hoshangabad and near Igatpuri on the G I. P. Railway. The broken and hilly nature of the Peninsula also causes the making of tunnels at some places to get over the obstructions. The railway building is, therefore, a much more expensive business in the south than it is in the Indo-Gangetic Valley.

The control of relief on the direction followed by the railway line is very marked in the south. Sometimes, the railway line has to make a long detour in order to avoid some obstruction or to take advantage of some gap. In Fig. 57 it is shown how the railway lines make detours to avoid crossing a number of streams which will need to be bridged. Fig 56 shows how a railway line turns to avail of a narrow river valley which is used also by a road.

There are two large areas in India which are particularly deficient in railways. These are (a) the Thar and Rajputana deserts and (b) the broken and hilly land of

Chhota Nagpur and Orissa. These areas are very thinly populated and have very little need for railways.

The almost complete absence of electrification of railways in India is a notable feature. In the following table the position of India is compared with some other countries and the world generally in this respect.

ELECTRIFIED RAILWAYS, 1939

	Electrified Route Miles	% of total Railway Mileage
Italy ...	3200	28
U. S. A. ...	2700	1·1
Sweden ...	2200	21
Germany ...	2000	5
France ...	1900	4·8
Switzerland ...	1800	50
Great Britain...	1000	4·9
Japan ...	450	2·3
India* ...	237	0·5
World ...	1600	2·6

Roads

The road is the indigenous means of communication in India. Over a large part of India road building of the unmetalled type is a simple affair and presents no great difficulty. Even the metalled roads were not unknown in India as the excavations at Mohenjodaro in Sind clearly show. The road is a much cheaper means of communication than the railway, but it is not so effective and serviceable, especially the unmetalled one, as the railway. During the rainy season the unmetalled roads become impassable in most cases, and even the metalled ones are seriously handicapped when floods invade them. On such occasions the railway alone, with its high embankment and efficient maintenance service, solves effectively the problem of

India*

G. I. P. Ry.	181	Route miles	4·85% of its total mileage
B. B. & C. I. Ry.	37	,,	1% ,,
S. I. Ry.	18	,,	0·7% ,,

[Capital, March 21,1940]

communication. But the railway mileage is small and cannot possibly serve cheaply all the needs of a vast and poor country like India. Roads, therefore, naturally play a very important part in the country's communication.

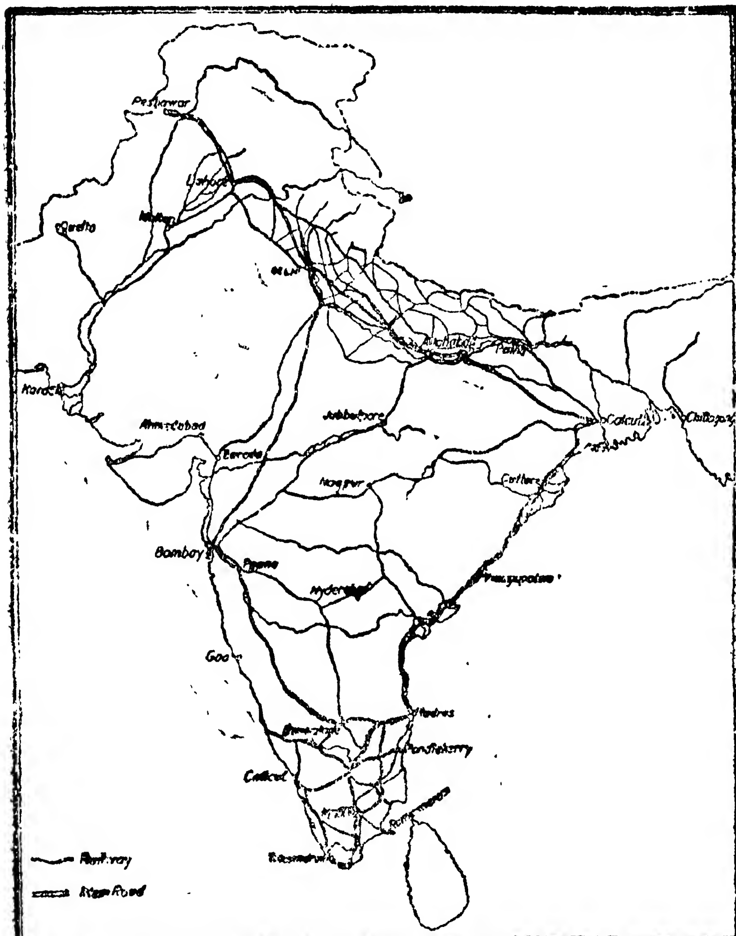


Fig. 58. Roads and Railways in India.

India had in 1935-36 about 3 lakh miles of roads. They gave an average of about 1¼ furlong of road for every square mile of area. Over most of the country 40 to 75%

of the area is not being served by a road at all. About a quarter of this (82 thousand miles) comprised of metalled roads. More than half of the metalled road is in the peninsular India where the old hard rocks facilitate the building of such roads. Of the unmetalled road, on the other hand, about four-fifth (77 p. c.) lies in the Indo-Gangetic Valley where the soft alluvium, the great distance from which the road-metal has to be obtained, and the frequent floods naturally favour the construction of the unmetalled road which is rebuilt cheaply after every rainy season.

After partition, the road mileage in India was about 2,46,000. Of this mileage about 66,400 miles were surfaced.

A Ten-Year Plan for road development known as the 'Nagpur Plan' was drawn up in 1944. According to this Plan the Indian roads were to be divided into four classes: (i) National Highways; (ii) State Highways; (iii) District Roads; and (iv) Village Roads. The National Highways are to be six in number, connecting the four towns of Delhi, Calcutta, Madras, and Bombay. This gives four highways; while the diagonals in this figure joining Delhi and Madras and Bombay and Calcutta via Nagpur give the other two highways.

The following table gives the mileage of surfaced roads and care in the different parts of India:—

	(000 Miles)	(000 Cars)
Madras	22	16
Bombay	11	19
U. P.	8	10
M. P.	6	3
Punjab	5	3
Bihar	4	6
Bengal	4	17
Orissa	1	—
Assam	1	—

The total mileage of these National Highways is to be 13,400 miles. For 11,800 miles of this roads already exist. The missing links totalling about 1600 miles have

to be built to complete the network of the National Highways. Of the 11,800 miles of roads that exist in this network, only about one-third have got an improved surface. The rest have to be well surfaced. Besides, about 12 new bridges have to be built also. The cost of the whole scheme is estimated at several hundred crores of rupees. According to the Nagpur Plan about 120,000 miles of other classes of road have to be built, so that no important village will be more than 5 miles from a road in an important agricultural region; and no village will be more than 20 miles from a main road.

Water Transport

India is a land of many rivers, and yet water transport has not made much headway in this country. There are certain geographical drawbacks under which water transport has to labour in India. During the rainy season the rivers are in high floods and consequently have a strong current which is not easy to navigate. During the dry seasons, on the other hand, only the big rivers have water throughout their course, others become disconnected pools in which navigation is impossible. Even in the big rivers the water is very shallow and there are sandbars due to silting which further reduce the depth of the water. There is a considerable distance of the dry bed of the river which must be crossed before coming to the water. Owing to the sandy nature of this bed vehicular traffic is almost impossible there. Over a large part of the country, thus, the towns on the river banks cannot make use of the river transport fully. Owing to the shifting river course, it is not possible to make any permanent jetty or wharf on these rivers. The multi-purpose schemes under construction in certain parts of India may improve the navigability of some rivers.

In Lower Bengal, Assam, and in the river deltas on the east coast, however, there is enough water in the rivers and navigation is possible throughout the year. These regions are not well supplied with railways or roads. This

fact naturally makes navigation the only efficient means of communication. On the Ganga in Bengal and Bihar and on the Brahmaputra in Assam a large number of steamers, apart from the small country boats, ply to cope with the large amount of traffic that is diverted to the rivers. The size of these steamers is limited by the minimum depth available during the dry season. Ocean-going steamers come upto Calcutta on the Hooghly with the help of continuous dredging. The current in the Ganga becomes sluggish in Bengal owing to the low height above sea-level. The rivers, therefore, deposit silt with considerable speed. Dredging has to be very active to keep the traffic channel in the river open.

Navigation canals are even less important than the rivers. The total mileage of navigation canals in India in 1935-36 was about 3,800 ; more than two-thirds being in Bengal and Madras. In the coastal districts of Bengal where no other means of transport is possible, canals are easy to build. The large number of BILS or depressions full of water are easily interconnected to provide a canal for navigation and for draining the land. Bengal has, therefore, the largest canal mileage in India.

The Buckingham Canal on the east coast in Madras, and the Orissa Coast Canal both let in sea water to provide sufficient depth for boats. These two are the largest navigation canals in India.

Some of the irrigation canals also allow small boats to ply. The delta canals on the east coast are the most important for this ; though some goods traffic passes on the Ganga canals also. Some of the irrigation canals in the Punjab allow timber logs to be transported in rafts. The Son canals also play an important part in navigation. They carry generally low grade cargo mostly sand, clay and stone etc., from the Kaimur hills.

The majority of the earlier irrigation canals were designed to combine navigation with their primary function of irrigation. In the absence of serious railway

competition in those days, high hopes were held of the possibilities of utilising these arterial waterways for navigation also. Communications were, at the time, both inferior and inadequate, and the new canals, passing as they did through fertile and populous country, appeared to offer a good opportunity for their improvement.

It is now realised, however, that the combination of irrigation and navigation cannot, unless the circumstances are very special, be successfully effected. There are various reasons for this. A canal designed primarily for irrigation must be aligned so as to afford command of a maximum area of cultivable land, without reference to the position of trade centres. The traffic attracted is consequently very limited. Moreover, in a highly cultivated tract large numbers of cattle are required for ploughing. These cattle are available for carting the surplus crops to market at a nominal cost to the owners. This fact, therefore, militates against the extensive use of canals for carrying foodgrains. The Ganga Canal, which is navigable throughout its length and passes through one of the richest plains in India, fails to recover in tolls from the boats even the small extra cost of maintaining navigation upon it.

The two most important navigable systems of irrigation works are the Godavari and the Kistna Delta canals in Madras. There are particularly strong reasons for using these canals for navigation. During many months in the year they carry away all, or nearly all the river water supply, and so cut off the upper waters of the rivers from the seaboard. They traverse flat and fully cultivated deltas in which there are no great falls to be overcome. These deltas are, besides, ill-provided with roads and other means of communication. The lower ends of the canals are connected by the sea; the head of each system is connected with that of the other. Thus, the upper waters of the Godavari and of the Kistna are connected with the Buckingham Canal. The facilities provided are, in such circumstances, a great boon to the cultivators. Yet even here it cannot be said that navigation is directly remunerative.

The four canals, the Kurnool-Cuddapah canal, the Orissa canal, the Midnapore canal and the Son canals are all navigable; indeed their primary object was navigation. But they are not a success.

The Buckingham Canal in Madras is a purely navigation canal. It runs parallel and close to the coast, joining up a succession of backwaters of the sea. It extends for 196 miles north and 66 miles south of Madras town. It joins with the Connanur canal of the Kistna Delta system.

The canal was open alike to river floods and to tidal flow and had no regulating works in the beginning. Heavy silting naturally occurred in the channel and traffic was greatly impeded under these circumstances. Experience also showed that the alignment had been taken far too near the sea and was consequently subject to damage from high tides and storm waves. Accordingly, remodelling was undertaken in 1883. The canal was realigned in parts so as to take it out of backwaters and further from the sea. An embankment, to protect it from waves, was also constructed along its eastern side. Floodgates were fitted across the channel where it entered and left the various backwaters and rivers which it crossed in its course. This was done to shut floods out of the canal. After 1893, most of these floodgates were replaced by a series of locks designed to retain a surface water level in the canal approximately up to the level of the highest prevailing tides.

Through traffic from the Godavari and the Kistna deltas to Madras has now disappeared on this canal, owing to the building of the Calcutta-Madras Railway, which runs parallel and close to the Buckingham Canal. The canal is now principally used for the transport of salt and firewood into Madras city from short distances south.

The total mileage of waterways in India is estimated to be 25,000 miles. Of these about 10,000 miles are river and 15,000 miles canals. The need for more transport

facilities in the country has diverted the attention of the Government to the improvement of water transport on the Ganga.

AIR TRANSPORT

Air transport is the least important of the means of communication in India at present. India has, however, a strategic position on the Air route to Australia. The main lines between Europe and Australia or the Far East have to pass, therefore, through India. British Overseas Airways Corporation, the French line (Air France), and the Dutch line (K. L. M.) the American Line (T. W. A.) all fly over India.

There are in the Indian Republic 70 airports; of these Dum Dum (Calcutta) is the biggest airport in Asia.

Of these airports Calcutta, Bombay and Delhi are on the International Air Routes. The airports are a few miles away from the main cities; e.g., the airports of Delhi are at Palam and at Safdarjang; of Calcutta at Dum Dum and Barrackpore; of Bombay at Santa Cruz and Juhu; of Madras at St. Thomas Mount; of Allahabad at Bamrauli, and so on.

Delhi, Bombay, Calcutta, Madras, Tiruchirapalli, Vishakhapatnam, Agartala, and Ahmedabad are the customs airports where taxes are paid on imported goods by the passengers.

Besides the airports, there are a number of airstrips for landing and take off of the planes. The Government of India is spending about half a crore of rupees every year on these airports and strips.

The progress of air transport in India is shown by the following table:

Year	Miles flown	Passengers carried	Freight carried (lbs.)
1948	12,648,765	341,186	11,968,736
1949	15,098,354	357,415	22,499,679
1950	18,896,139	452,869	80,006,755

Airways in India depend for their success largely upon the mails that they carry.* It will, therefore, be right to give the story in brief of the improvement and development of air mail in India.

In April, 1929, was started the first regular Air Mail Service from India. A direct air mail service was established between England and India, and mails for most of the countries in Europe and for Iraq, Palestine, Egypt, Persia were sent by this service. The Indian State Service, a State-owned air mail line was established in December, 1929; between Delhi and Karachi to connect with the Imperial Airways Service between India and England. This service was operated by the Delhi Flying Club from January, 1932.

In 1930, the Royal Dutch Air Company established a fortnightly service between Holland and the Dutch East Indies across India. A French Air Company also began to operate in the same year the Marseilles-Saigon Air Service across India. These services dropped mails for India at the frontier posts of entry and were not allowed to carry internal Indian traffic. In 1932, however, it was decided to use both services for the carriage of Indian foreign mails to places which were not served by the British air services.

An air parcel service was introduced between Great Britain and Northern Ireland and India in May, 1931, and in July an air mail postcard service was also introduced. An air mail postcard, first of its kind in the whole world, was put on sale to the public, bearing a stamp and a blue air mail label printed thereon.

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*The Mails carried by Air.

				Lakh lbs.
1948	...	...	...	16
1949	...	...	...	50
1950	...	...	...	83

In January, 1932, the Cairo-Mwaza Air Mail Service of Imperial Airways was extended to South Africa and the first despatch of the air mails from India for South Africa was made from Karachi on 20th January, 1932.

A feeder service was started in 1932 between Karachi, Bombay and Madras connecting at Karachi with the London-Karachi service. This was made possible through the enterprise of the Tatas Limited under a ten-year contract with the Government of India. The internal service between Delhi and Karachi maintained by the Delhi Flying Club ceased to operate from 4th July, 1933. A new Company, called the Indian Trans-Continental Airways Limited, working in conjunction with the Imperial Airways Limited started from 7th July, a weekly air mail service between Karachi and Calcutta. The service was extended to Rangoon VIA Akyab from 1st October, 1933, and to Singapore from 15th December, 1933.

The Indian National Airways Limited introduced from 1st December, 1933, a daily mail and passengers service between Calcutta and Dacca and a weekly service between Calcutta and Rangoon. The Madras Air Tax Service started from 10th February, 1934, a bi-weekly air mail service between Madras and Calcutta. Later on, however, these services ceased to operate. A new weekly air mail service was started from December, 1934, between Karachi and Lahore, the service being operated by the Indian National Airways Limited. This service was later duplicated.

In 1935 increased facilities for the transmission of correspondence were provided. The service between Calcutta and Singapore was duplicated and operated jointly by Imperial Airways and Indian-continental Airways. A connection was established at Athens between the westbound places from Karachi and the north-bound places of the Greece-Germany Air Service. Use began to be made of tha air service operated by Imperial

Airways between Khartoum and Kano (Nigeria) for the despatch of air mail to West Africa. A new weekly air service was established towards the end of 1935 by Tata Sons Limited for operation during May between Bombay and Trivandrum.

Since 1935 air mail correspondence for places in the United States began to be accepted for despatch by the internal air service in that country. Correspondence for South America also was accepted for transmission by air VIA Germany or France.

In 1936 the service between Singapore and Australia was duplicated, the Khartoum-Kano weekly service was extended to Lagos and a weekly air mail service was introduced between Penang and Hong Kong.

Another internal air service was opened between Bombay and Delhi in November, 1937, and yet another from Bombay to Kathiawar in November, 1938. Simultaneously with the introduction of this scheme, the frequency with the internal feeder services, namely, Karachi-Madras and Karachi-Lahore was increased first to four and then to five times a week. Karachi-Madras service was extended to Ceylon and Bombay-Trivandrum service to Trichinopoly to connect with the Karachi-Colombo service.

After partition, the Air Communication in India was reorganised. Delhi was now connected to Bombay from where planes took off for Europe. The foreign companies still make use of Karachi for this purpose.

Some of the regular internal services now operating in India are those between (i) Bombay and Calcutta, (ii) Delhi and Calcutta via Lucknow, (iii) Delhi and Madras via Nagpur, (iv) Delhi and Srinagar, (v) Delhi and Bombay (vi) Calcutta and Madras, (vii) Patna and Kathmandu and (viii) Delhi and Dibrugarh via Patna. The following Air Companies were operating in 1950 :

			Monthly miles flown (Lakh)
Air India Ld.	...	...	3·67
Airways India Ld.	...	...	1·48
Ind. Nat. Airways	...	...	1·48
Himalayan Airways Ld.	...	...	1·27
Bharat Airways Ld.	...	...	1·14
Deccan Airways Ld.	...	...	1·08
Air Services of India	...	...	·95
Indian Overseas Airways Ld.		...	.62

From June 1, 1951 the Deccan Airways, recently taken over by the Government of India, commenced operating the Night Air Mail service when their first Nagpur-bound plane took off from the Dum Dum airport with about 100 bags of mail and 13 passengers.

QUESTIONS

1. What are the geographical causes of India's backwardness in transport facilities ?

2. Discuss carefully how the physical features of India control the building of roads and railways.

3. To what extent has water transport been developed in India ? What are the geographical difficulties in the way?

4. What are the main air routes in India ? What geographical factors, if any, control these routes ?

5. What is the position of the Indo-Gangetic Basin in India in respect of :—

(*a*) Road transport.

(*b*) Railway transport, and

(*c*) Water transport ?

CHAPTER XI

TRADE

Trade is a .symptom of civilization. The economic progress of a nation or an individual is based upon trade. One nation or individual exchanges its surplus production for the surplus of another nation or individual. In this way, everybody tends to produce only that commodity for which nature has given him the greatest capacity. Climate, topography and social organisation determine the capacity for production. They also on the other hand, determine the needs (in other words, market) for commodities. The origins and trade are thus the function of geography.

India contains a little more than one-fifth of the total population of the world. Yet, the poverty* of her people prevents her having a large trade. The total foreign trade of India is less than that of Great Britain whose population is only about one-sixth of India's. Even the internal trade of India is far below the standard expected in modern times from a country with such a large population. The smallness of India's trade is due to her low production. We have noted in this book our backwardness in agriculture, as well as in industries. We do not produce enough ; and unless we produce enough, we cannot have large quantities of goods for exchange or be rich. India's problem is, therefore, one of Production first and of Distribution second.

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* National Income ($)

U. S. A.	1381
Great Britain	1069
Australia	980
U. S. S. R.	320
India	200
China	120

[Colin Clark's estimates].

India is essentially an agricultural country, and her trade, both internal and external, must be characterised, therefore, by the movement of heavy commodities. The paucity of roads and railways is a great drawback in this respect. The difficulties of transport limit the markets for Indian produce. The building of railways and roads in India, and the cutting of the Suez Canal across the Isthmus of Suez opened up new markets for India's agricultural products. With her increased exports, India could now buy larger quantities of goods produced in the world, especially in Europe. The trade began to grow considerably in volume, therefore, since the last quarter of the 19th century.

The foreign trade of India is of great significance, for it is this which provides the country machines, chemicals, raw materials and manufactures without which we cannot progress.

The following are the salient features of our foreign trade :—

1. Our foreign trade is carried mostly by sea.

The yearly average of the total sea-borne trade of India in merchandise on private account alone amount to Rs. 334 crores.

2. The per capita share of the foreign trade of our country is much lower than in Europe or America or Japan.

The foreign trade of India has undergone many changes during the last few years, owing to the effects of the World War and the partition of the country. The export and import of commodities 'is no longer completely free. Licenses are now required for this purpose from the Government. The control of our foreign trade has been necessitated :—

(a) because there is a shortage of some raw materials in the country, e.g., raw cotton and raw jute, and therefore their minimum supplies for home use must be guaranteed.

(b) because there is a shortage of dollars in the world, and therefore exports to dollar areas must be encouraged. For it is with the dollars that a large part of our food, our machinery, and other manufactured articles are paid for.

(c) because our resources of foreign exchanges or money with which we pay for our imports are limited, and therefore we cannot import as we like.

In this respect, it is important to remember that the currencies of the world are divided today into hard currency and soft currency. The dollar represents the hard, and the £ sterling the soft currency. Export to the hard currency areas and imports from the soft currency areas are to be preferred. The payment for the imports is made with the exports of commodities or labour or foreign money. As the hard currency areas export more to other countries than they buy from them, therefore these other countries are always anxious to get dollars from any source they can, to pay the hard currency areas. This fact has, therefore, led to the control of foreign trade in all the soft currency areas.

During the last World War trade control became very much marked, due to war requirements. After the War the control was necessary for economic rehabilitation. In India, the creation of Pakistan complicated this issue considerably. But in order to expand trade without detriment to internal requirements export controls were liberalized in 1949. They had been in force since the War because of the internal shortage of goods. Subsequently, they were found helpful in developing exports and thus earning foreign money. In 1950, certain restrictions had to be imposed against the exports. However, after the heavy adverse balance of our foreign trade in 1949, the emphasis was shifted from export control to export promotion.

The value of the foreign trade of Indian Republic is given below :—

	1948-49	1949-50	1950-51
Imports (Crores of Rs.)	517	560	565
Exports "	422	485	585

The export and the import trade is divided into three main classes : 1. Food, Drink and Tobacco ; 2. Raw materials and unmanufactured articles ; and 3. Articles wholly or mainly manufactured. The total value of these classes is given below in crores of Rupees :—

	I class (Food)		II class (Raw Material)		III class (Manufactures)	
	Imp.	Exp.	Imp.	Exp.	Imp.	Exp.
1949–50 ...	122	117	144	111	288	253
1050–51 ...	106	133	198	140	258	311

•It will be noted from the above table that manufactured articles dominate both the import as well as the export trade. The manufactured articles have become important in the export trade only in recent years after the War.

The following table shows the most important items of the import trade :—

	1949–50	1950–51
Machinary	105	84
Cotton, raw and waste ...	63	100
Grain, Pulse and Flour ...	99	80
Oils	59	59
Metals and Manufactures ...	31	45
Vehicles	23	24
Chemicals	16	19
Cutlery and Hardware ...	15	14
Dyes	11	14
Paper and Stationery ...	9	10
Electrical goods	13	9
Fruits	6	9
Tobacco	2	2

A careful study of the import trade of our country will reveal that articles manufactured wholly or mainly of iron and steel amounted to more than 152 crores of Rupees in 1950-51. This was about 27% of the total import trade of the country ; and was larger than that of any other commodity. The reason of it is to be sought in the backward state of our own iron and steel industry which is regarded as a key industry.

The following table gives the salient features of our export trade :—

Exports (crores of Rs.)

	1949-50	1950-51
Cotton Manufactures and yarn ...	74	134
Jute " " ...	127	114
Tea	72	78
Oils, cakes and seeds ...	8	38
Hides and Leather (all) ...	27	29
Spices	19	24
Raw Jute and waste ...	23	22
Tobacco	13	14
Gums etc, ...	9	13
Mining Produce	11	13
Raw cotton and waste ...	19	17

The textile group (all kinds) heads the list of our exports. In 1950-51 the total value of the exports of all kinds of textiles was a little more than 300 crores of Rupees. This was about 51% of the total value of exports. This means that the bulk of our exports is comprised of a few commodities ; while the imports consist of a large miscellany If we add to the textile group the value of tea and oil, etc., we notice that in 1950-51 about 70% of the exports were accounted for. About half of the exports are directly the produce of agriculture.

When we look at the geographical distribution or the direction of our foreign trade, we note that the largest share of this trade is with United Kingdom and U. S. A. The largest share of our imports (22%) and the largest share of our exports (23%) in 1950-51 was accounted for by United Kingdom. The U. S. A. came next with 20%. Australia, Egypt, Iran, Italy, and Japan are other important countries in our foreign trade.

The following table gives the values (crores of Rs.) for 1950-51 of the import and export trade :—

	Imports From	Exports To
United Kingdom ...	122	132
U. S. A.	115	111
Iran	37	6
Australia	33	30
Egypt	33	5
Japan	18	6
Burma	18	22
Canada ...	18	13
Italy	15	12
Thailand ...	8	5
Switzerland ...	7	2

India has the largest trade with the United Kingdom not only because we had been under the British rule in the past, but also because Britain owes us money on account of the last World War. This money is known as the 'Sterling Balances'. We can get back this Balance only in the form of goods.

Britain supplies us mainly manufactured articles, and buys from us raw materials and tea. The following tables show the contents of our trade with Britain :—

INDIA'S TRADE WITH THE U. K.

PRINCIPAL EXPORTS TO

	Full year
	1950 Lakh £
Total All Exports	983
Of which :—	
Tea...	347
Tobacco	78
Other non-metalliferrous mining and quarry products	12
Non-ferrous metalliferrous ores and scrap ...	14
Raw cotton and waste	38
Wool, raw and waste and woollen rags... ...	19
Raw jute	4
Seeds and nuts for oils, oils, fats, resins and gums	41
Hides and skins, undressed	13
Woollen and worsted yarns and manufactures*	29
Coir mats and matting	22
Jute manufactures	59
Oils, fats and resins, manufactured	12
Leather and manufactures	111

*Mainly carpets, floor rugs. etc.

PRINCIPAL IMPORTS FROM

	Full year 1950
Total All Imports	968
Of which :—	
Machinery	360
Vehicles (including ships aircrafts and locomotives)	182
Iron and steel and manufactures	60
Pottery, glass, abrasives, etc.	12
Non-ferrous metals and manufactures	25
Cutlery, hardware, implements and instruments ...	31
Electrical goods and apparatus	66
Cotton yarns and manufactures	11
Woollen and worsted yarns and manufactures ...	27
Silk and artificial silk yarns and manufactures ...	9
Chemicals, drugs, dyes and colours	74
Paper, cardboard, etc.	13

Inland Trade

In a country as big as India with a vast population, inland trade naturally assumes gigantic proportions. India, however, suffers from a great drawback in this respect. Her network of communications is not complete. There are extensive areas in India without any road or railway. In spite of this drawback, large quantities of goods are transported over different parts of the country. Before the War foodgrains of different classes (rice, wheat, barley, millets, maize, gram and pulses, etc.) formed the most important item of the inland trade of India. Most of these grains travelled only short distances, as they are cheap and bulky and cannot, therefore, stand high cost of transport.

Before the War wheat enjoyed a privileged position. It is a valuable foodgrain largely in demand by the rich

and the urban populations. The important areas of production of wheat, however, are confined to one part of the country. These two facts, viz., the widespread demand and concentration of supply areas, led to a vast inland trade in wheat. In Fig. 59 it is shown that while

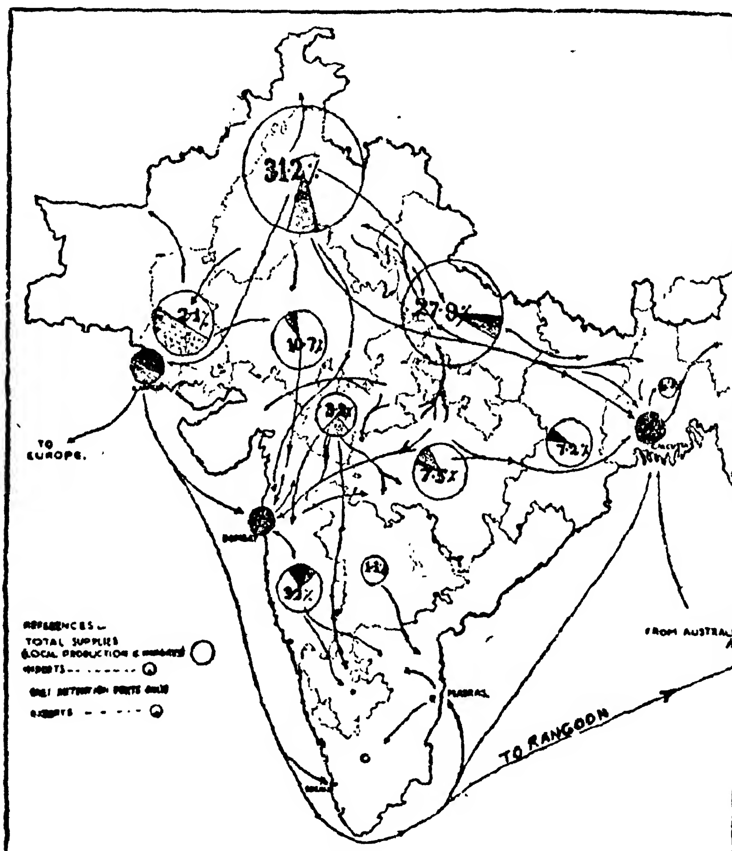

Fig. 59. Showing Wheat Supply and Wheat Trade before War.

the largest areas of production (shown by larger circles) are situated in one corner, the most important areas of demand (Calcutta and Bombay upon which the supply arrows converge) lie in another corner.

Another point that emerges from the above map is that while the movement of wheat was very widespread over the country (shown by the numerous arrows), the total quantities of wheat moved from the province were not very large. The dotted portion of the circles of supply representing exports bears a very small proportion to the circle as a whole.

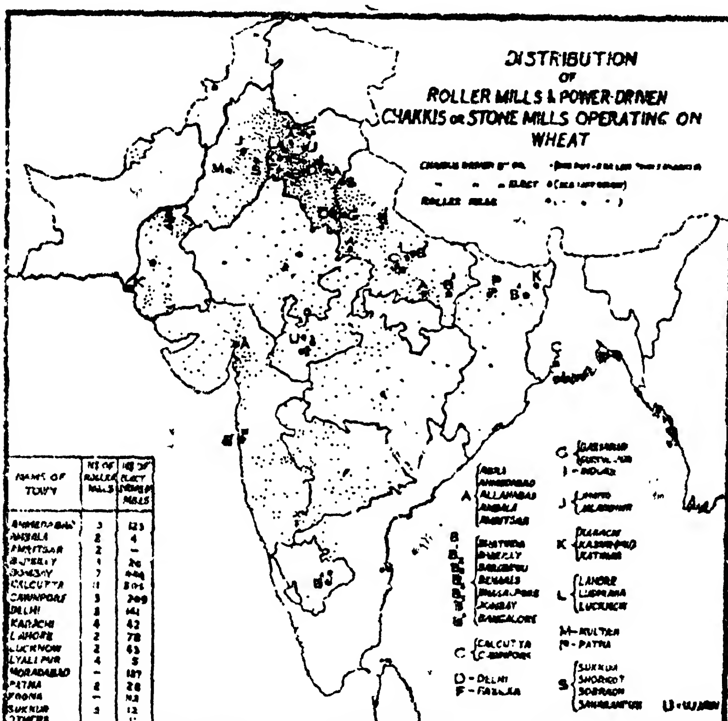

Fig. 60.

Wheat is consumed, not as grain but as flour. This fact necessitates the erection of a large number of flour mills or CHAKKIS all over the country. There were in India in 1936 more than 16,000 power-driven chakkis and 80 roller mills to grind wheat into the different types of flour in demand. Fig 60 given above shows the distribution of chakkis in India. This map, when com-

pared with Fig. 19 on page 89, will show that the distribution of chakkis is closely related to the wheat production.

The following table shows some of the important commodities entering into the inland trade of India in 1948-49 by rail :—

	Quantities (million Mds.)
Coal and coke	476
Oilseeds	23
Iron and steel	37
Jute	8
Salt	31
Cotton-raw	14
Sugar	19
Cotton piecegoods	6
Gur	10
Pulses and Flour	24

IMPORTANT PORTS

Practically all the foreign trade of India passes by sea, because the countries on her land frontier are poor and inaccessible and neither buy nor sell much. This sea-borne trade is concentrated only on a few ports of India. Calcutta, Bombay, and Madras handle almost the whole of the sea-borne trade of India. There are, however, a number of small ports both on the west coast and the east coast of India which handle a large amount of this foreign trade as part of the coastal trade.

The geographical factors determining the port sites on the western and eastern coasts are somewhat dissimilar. On the west coast from Cape Monze to the little town of Bulsar the coastal plain is low over extensive areas, its general flatness being broken only by the volcanic hills of Cutch and Kathiawar, and the Girnar Hills of crystalline rock, also in Kathiawar. There are two conspicuous features on this section of the coast. (1) The Rann of Cutch, and (2) the Gulfs of Cutch and Cambay.

The Rann is dry and passable by foot during the winter months, but invaded by the sea at the outset of the Monsoon.

One of the most important factors in the geography of the west coast of India is the sedimentation, for it has played a very important part in various ways in determining port sites. The general trend of currents impinging on to this coast is from the west and south-west, and as the currents set into the Rann and the Gulfs of Cambay and Cutch, they have the effect of increasing the degree of sedimentation. Owing to the fact that strong currents set in, in an easterly direction past the mouth of the Indus, the silt from that river is carried into the Gulf of Cutch and into the Rann, while currents setting into the Gulf of Cambay prevent the free movement of Tapti and Narbada silt out of the Gulf. The result is that these regions have been silting areas for a long time. It has been estimated that the channel approach to Bhavnagar has silted as much as 40 ft. in the last 50 years.

There is a striking contrast between this section of the coast and that which lies to the south of Cambay. It is mostly low land possessing a flat, deeply indented coast, the extensive gulfs contain waters which are difficult to navigate either by reason of insufficient depths or roughness, while the creeks provide poor harbours because of their tendency to become silted, or because distributaries may forsake them. South of Bulsar the Deccan Trap occurs. The coast becomes rocky and island strewn, and the narrow coastal plain, varying in width from 70 miles in the north to under 30 miles in the south, is overlooked by the steep escarpment of the Western Ghats. These features continue southwards until in the extreme south a low swampy coast is again found in the silted Cochin lagoons.

The low coasts on the west have a rainfall below 50 in., the middle section has from 50 to 100, while the southern area of metamorphic rocks and lagoons has over 100 inches.

In short, the chief drawbacks for ports on the west coast are: shoals, the strong undercurrents, the amplitude of the tides, and the irresistible rush of tidal currents.

Bombay

The value of the site of Bombay lies in available depth of water. The minimum depth up the main channel is 32 ft., and there is a minimum of 37 ft. of water at all states of the tide in the deep water anchorage in front of the docks. The 32 ft. minimum is equal to the maximum available in the Suez Canal through which the majority of the ships visiting Bombay have to pass.

Bombay's communications with the interior are also good, for the Thal Ghat and the Bhor Ghat, the two points where the wall-like Western Ghat mountains are rendered sufficiently low, are within fifty miles of each other and are behind Bombay. They collect up the communication lines to focus them on to the Port. This means that the productive hinterland of Bombay, producing the surplus essential to every port, extends to include the fertile agricultural lands of the Deccan and also in the Ganga Valley.

Bombay's greatest advantage as a good natural harbour is afforded by its island position. In Fig 71 the position of the docks in the shelter of the island of Bombay is safe from storms of the open sea. The rail and road communications between the port and the mainland across the narrow creeks provide another advantage to Bombay. Bombay is the nearest large port to Europe and North America with which we have the most of our foreign trade.

Because of the depth of water in the harbour, the largest ships visiting India can come to Bombay only. All other ports in India can accommodate only ships of small tonnage. On account of the sedimentation noted above, it is necessary to employ dredgers continuously to keep the channel clear for big ships. The Bombay port

has a large number of competitors especially in the ports situated in Kathiawar. Calcutta has an advantage in this respect over Bombay, because the geographical conditions near Calcutta do not enable any rival port to develop

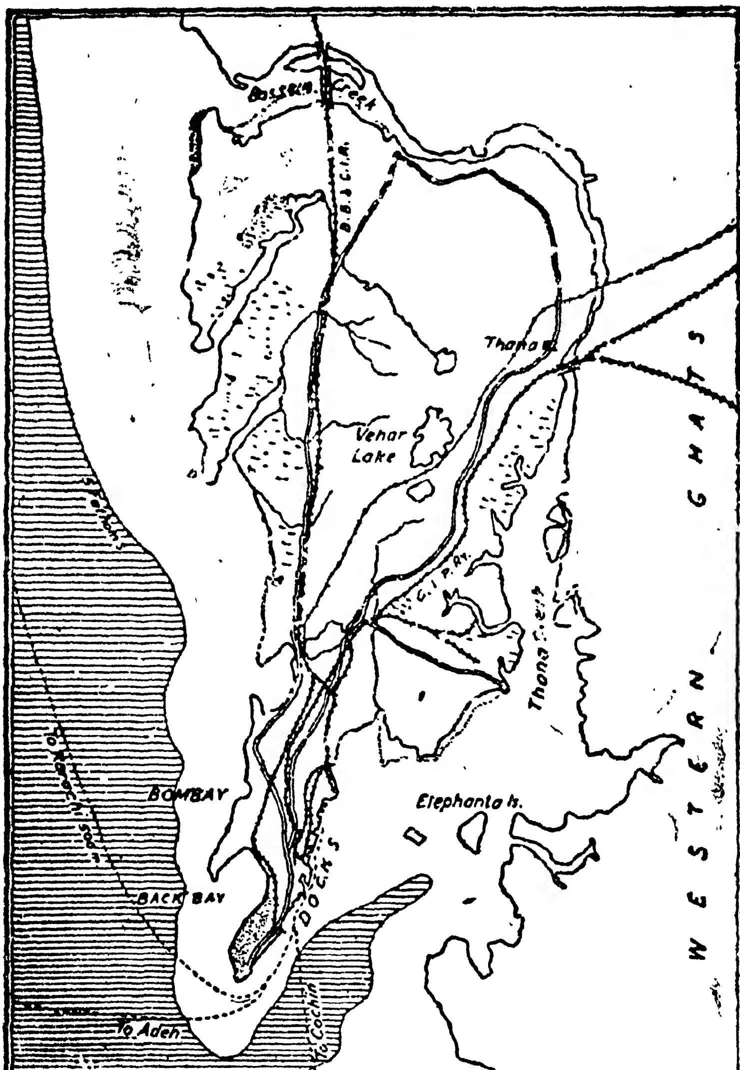

Fig. 61. Site of Bombay.

Bombay's position is unassailable as a Passenger port, because the passenger ships are generally of large tonnage which can be accommodated only in Bombay.

KATHIAWAR PORTS

Kathiawar with a coastline of about 500 miles and with only a small population possesses a number of seaports of considerable importance. By its geographical position Kathiawar is best able to serve the trade of Rajasthan and the neighbouring regions. The trade at the Kathiawar ports generally benefits from the cheaper wharfage and storage charges. The labour charges are also lower than at Bombay. The trade between Kathiawar and Rajasthan is carried by the metre gauge and the broad gauge without the necessity of change from one gauge to the other, as is the case with the trade between Bombay and certain parts of Rajasthan.

The most important Kathiawar ports are :—

(1) Bhavnagar, (2) Bedi Bunder, (3) Port Okha, (4) Navlakhi, (5) Verawal and (6) Porbander.

1. Bhavnagar lies half-way up the Gulf of Cambay on its western side. There is enough warehousing accommodation at the port and a good railway connection with the whole of India. Ships anchor about eight miles from the port and cargo is brought to the port by barges. Owing to the constant silting, a new deep harbour was constructed in 1937 which can accommodate two ships at all times of the year.

2. Bedi Bunder was the first port to be developed in Kathiawar. It is situated in the Gulf of Cutch, with a long line of sheltered sea coast, and has the unique advantage of being open at all seasons of the year.

3. Port Okha is situated in a detached part. It is located at the extreme north-west point of the peninsula of Kathiawar accessible readily to all steamers trading along that coast. The main disadvantage of this port is that the approach to channel from the sea is circuitous and risky. Another drawback is that Okha is far removed from large centres of population.

4. Navlakhi is the principal port of Morvi and is situated on a spit of land in a tidal creek within the Little Gulf of Cutch. Large vessels can only come within a mile or so of the port after navigating mud banks at the entry to the Little Gulf. However, as the port is not exposed, it can be kept open throughout the year.

5. Verawal is a roadstead anchorage with masonry piers built at right angles to the shore. It admits of small craft coming alongside the landing stage at all stages of the tide.

6. Porbander is also an open roadstead, but with coral reefs protecting the inner harbour. There is a considerable traffic, which includes passenger traffic with East Africa. The harbour is closed during the monsoon.

To take the place of Karachi, which is now in Pakistan, the Government of India are developing Kandhla as a major port. Kandhla is situated about 30 miles from the town of Bhuj and is on the Rann of Cutch. The water here has generally a depth of 30 feet, but there is a sandbar near the opening to the port, which reduces the depth. Work is proceeding on the improvements to the port. The rail connections with Deesa-Radhanpur on the meter gauge and with Jhund on the broad gauge are under construction. The supply of drinking water is also receiving attention. When work is completed the cheap land and the proximity to the port is likely to develop the area around Kandhla.

The port of Vizagapatam was developed by building an improved harbour in the hope of handling the increased traffic in manganese ore, as most of the manganese ore in India occurs in its vicinity. The hopes of increased traffic were belied, owing to the fall in the exports of manganese ore due to world competition. The port is the site of the new ship building docks of the Scindia Company.

Madras, Cochin, and Tuticorin are other important

ports in India. The trade handled by these ports is small. In 1950 the trade handled was as follows :—

(Lakh Tons)

	Imports	Exports
Madras	14	2
Cochin	10	2

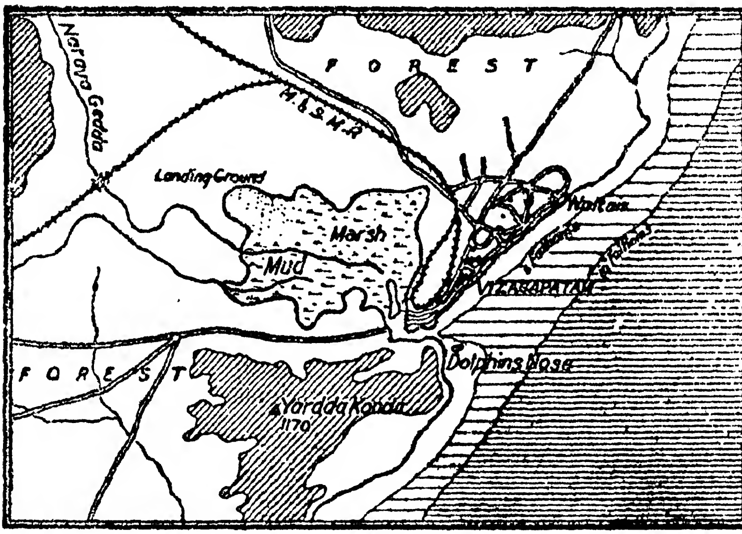

Fig. 62 Site of Vizigapatam.

CALCUTTA

Calcutta is the largest port in India. In 1950-51 it handled about 16 lakh tons of imports and about 36 lakh tons of exports. It is situated about 80 miles away from the seashore. The Diamond Harbour has been built near the sea on the Hooghly for the stay of ships awaiting the favourable tide for ascending to Calcutta. In Calcutta, for loading and unloading of goods permanent docks have been built at Kidderpore.

Like all other estuarine ports, Calcutta's shipping is at the mercy of the tides. The ships can enter and clear the port only at fixed hours corresponding with the tides. There are also a number of sandbars in the Hooghly

which determine the size of the ocean-going ships by the depth of water. The sandbars are particularly numerous in the Hooghly, because of its tortuous course reducing the speed of the flow of the water and causing deposition of silt. The silt brought down by the Damodar river also causes sandbars.

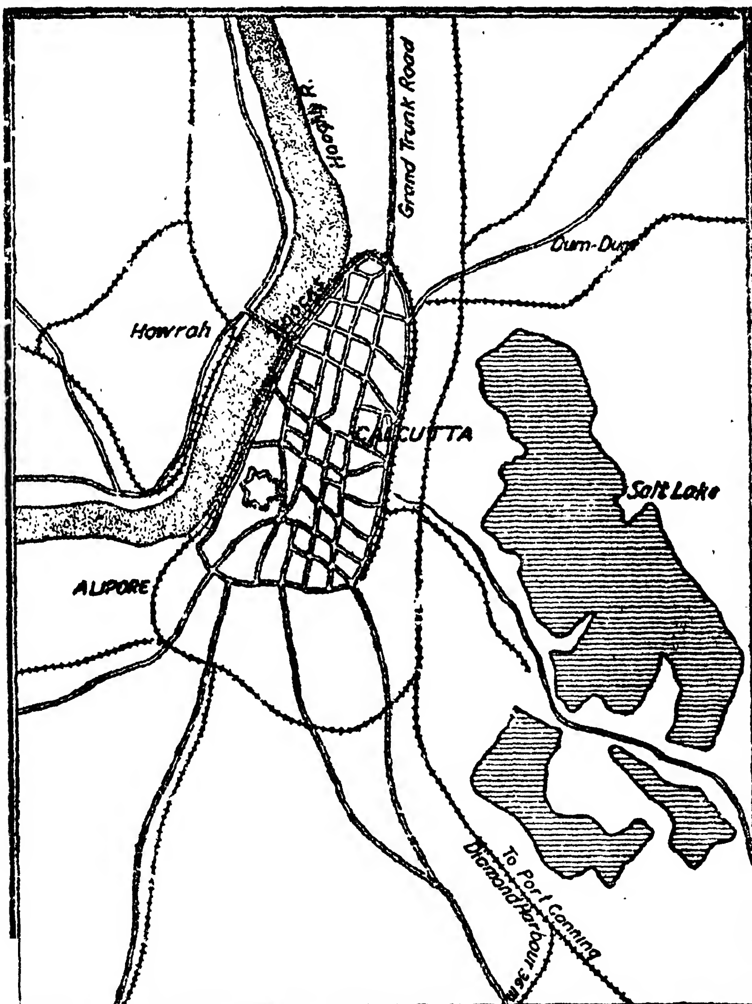

Fig. 63. Site of Calcutta.

The bars and crossings encountered in the river on the journey to the open sea are Panchparia Crossing, Sankrall Crossing, Manikholi crossing, Pir Serang crossing Poojali crossing, Moyapur Bar, Royapore Crossing, Fulta Crossing, Eastern Gut Bar (known also as the JAMES AND MARY) Kukrahatti Crossing, Balari Bar, Auckland Bar, Saugor Crossing, and Middleton Bar.

While these names may appear somewhat meaningless to the layman, to those connected with the river they are of paramount importance. For instance, Saugor Crossing is the controlling bar in the river.

At this crossing there is perhaps only 24 to 30 feet of water—at times a little more—and before the ships can enter or leave the port it must be conclusively ascertained that there is sufficient water on the bar to take a ship of any large draught.

This is only one of the many points which have to be carefully checked by the pilot before the navigation operations are started.

Cases have been known where a ship has crossed the controlling bar with but a few inches of water under her keel—and on more rare occasions vessels have actually scraped sand. More often than not ships anchor at Saugor, and wait for the next tide. Of course certain vessels, for instance, the Rangoon Mail steamers make the journey very rapidly sailing up or down the river in roughly eight hours. To shorten the distance, there is a proposal to dig a canal from Calcutta to the Diamond Harbour. The length of this canal will be 30 miles.

Calcutta has the advantage, on the one side, of being at the head of the Indo-Gangetic Basin which is the most densely populated area in India. On the other hand, it is at the head of the biggest estuary of the Ganga, in the Bay of Bengal. It is also connected easily with the eastern coastal plain and with the interior of the Plateau Region. It is naturally the largest town of India. The port is well connected by railways, roads and the river to its hinterland. It also has the advantage of having

in its hinterland a jute industry depending exclusively on foreign trade, India's premier coal mines, iron mines, petroleum mines, the mica mines, the manganese mines, and the tea estates, the products of all of which find their foreign market through Calcutta. The iron smelting industry of India producing pig-iron for export is also in its hinterland. Under the circumstances, Calcutta is bound to be an important port of India. From the nature of things, Calcutta's trade is mostly in bulky and heavy articles which are not as valuable as the articles handled at Bombay. Owing to the tedious and dangerous river journey, passenger traffic at Calcutta is not large. It is mainly with Burma. This traffic is handled in small ships, for the big passenger ships of the regular lines never visit Calcutta, owing to the difficulties of river navigation.

The following shows the total trade handled by some important ports of India in 1948-49.

			Lakh Ton
Calcutta	...	...	80
Bombay	...	...	60
Madras	...	...	25
Cochin	...	...	20
Vizigapatam	...	...	5

QUESTIONS

1. Discuss carefully the salient features of India's foreign trade.

2. What are the important geographical factors determining port sites on the Western Coast of India ?

3. What geographical factors have been responsible for the development of Bombay as a Port ?

4. Discuss fully the position of Calcutta as a Port.

5. Compare the trade (export and import) of Madras with that of Bombay. Account for differences, if any, in their export trade.

6. How far are India and Great Britain dependent on each other for (*a*) raw materials, (*b*) manufactured goods? Give reasons for your answer.

7. Which countries are the chief buyers of our manufactured cotton, oilseeds and tea? From where do we import machinery, silk and paper?

8. What are the principal exports of India? Where is each produced and where is it sent?

9. Write explanatory notes on the following :—

(*a*) Ports in South India.

(*b*) Oilseeds trade of India.

(*c*) Air-routes of India.

CHAPTER XII

POPULATION

India occupies a unique position in the world in respect of her population. She supports one of the largest populations on the face of the earth. Monsoon climates have the notable feature of supporting very dense populations, and India, being the largest monsoon land in the world, naturally has the most outstanding position in this respect.

The distribution of population is controlled by :—

(a) the production of food ; or

(b) the means to purchase food.

In industrial and commercial areas the incomes of people are considerable and they can, therefore, easily purchase the food that they require from other areas. These incomes, therefore, attract large populations which could not be supported by local production of food alone.

In agricultural areas, however, the incomes are comparatively low and the people have, therefore, to produce their own food. The density of population here is, thus, dependent upon the capacity of the local area to produce food.

In India the question of population is the question of the means of livelihood or the question of FOOD. More the food, greater the population. We find, therefore, that all those factors which affect the distribution of food in India also affect the distribution of population. It has been seen elsewhere in this book how the distribution of rainfall, the fertility of the soil and irrigation facilities determine the quantity of food that can be grown. It has also been noted how, quantity for quantity, rice supports more people than wheat or millets. It can be safely concluded that the distribution of population in India follows rice, and consequently rainfall ; for rice is culti-

vated generally in the moister regions of India. A comparison of the population map given below, with the rainfall map on page 18 and the rice map on page 82 will support the above conclusion.

The population map on this page shows that the MOST DENSELY POPULATED parts of India are found (i) in

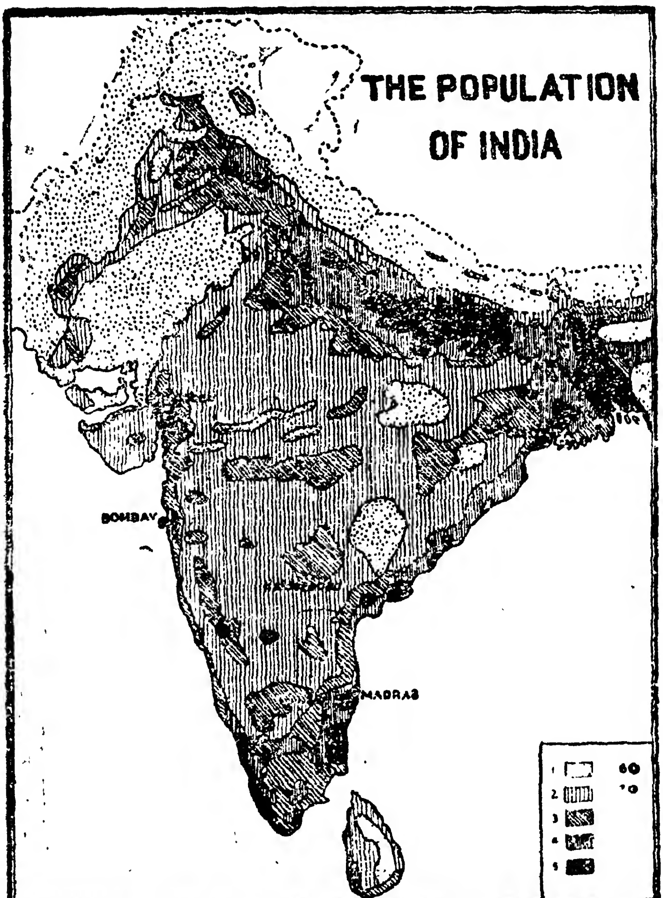

Fig. 64. Population Density.

[(1) Less than 25: (2) 25 to 75. (3) 75 to 150. (4) 150 to 250. (5) Over 250. (6) Towns of 5 lakhs or over. (7) Towns 2·5 to 5 lakhs.]

the valley of the Ganga, (ii) in the river deltas of the south, and (iii) the south-western coast comprising Travancore and Cochin. The greatest density per square mile (averaging over a thousand people) is recorded in Cochin, Travancore and certain districts in Assam.

The THINNEST POPULATION is found in (i) the hilly areas (the Himalayas and the associated hills), (ii) the desert of Rajasthan and (iii) the dry areas of Chhota Nagpur plateau, Bastar and Orissa.

In the Ganga Valley, the density decreases as one proceeds towards the north-west, because the rainfall becomes less and less. This does not, however, apply to those areas where irrigation facilities are abundant and the soil is fertile. Thus, in the Meerut Division with a vast network of canals and fertile soil, the density of population is high, even though the rainfall is low. In the lower valley of the Ganga and in the delta the population is thin, (even though the rainfall is heavy), because large areas are covered by the stagnant waters of the old beds of rivers which now breed malaria. It must be remembered that rainfall controls the density of population in India only through its control on food production.

The greatest populations in the Punjab occur in the neighbourhood of the Himalayas where the rainfall is considerable and the irrigation facilities from wells and canals are also abundant. The importance of irrigation facilities in the distribution of population in India is shown in the newly populated canal colonies of the Punjab. Areas which were unpopulated deserts before the advent of canal irrigation show now fairly dense populations in the Punjab.

In the Peninsula, except on the coastal plains, the density is generally low. This low density is due, firstly, to the broken topography of the Peninsula and, secondly, to the forests that grow in areas of heavy rainfall. These forested regions are usually unhealthy, owing to bad drainage.

India being an agricultural country, most of her population lives in small villages. There are about six lakhs of villages in India. By far the largest proportion of these villages is of villages with a population below 500. According to the census of 1931 this proportion was 73%. More than one-fourth of the total population of the country lives in such villages. The following table shows the percentages of India's population living in villages or towns of different sizes :—

DISTRIBUTION OF INDIA'S POPULATION, 1931

Size of village or town	No. of villages (000)	Per cent of total population
Under 500 inhabitants ...	510	27·5
500–1,000	113	22
1,000–2,000	54	20·5
2,000—5,000	19	15
Towns :—		
5,000—10,000	2	4
10,000–20,000	...	2
20,000—50,000	...	2
50,000—above	...	7
Total No. of Villages ...	696,831	
Total No. of Towns ...	2,575	

The low proportion of city-dwellers is a marked feature in India. In this country of about the size of Europe excluding Russia, there were only 36 cities with a population of over a lakh. Out of these, 15 were in the Indo-Gangetic Valley.

A little less than one-half of the total number of villages in India is in the Indo-Gangetic Valley; the valley of the Ganga being the more important. The num-

ber of villages in the Ganga Valley was about 272,000 in 1931. The largest number of villages in India is found in the U. P. Generally speaking, owing to the fertility of the soil and the consequent capacity to support large population the villages are more closely settled in the valley of the Ganga than in other parts of the country. In Bengal the average area falling to the share of one village is a little less than one square mile. In Bombay, on the other hand, the average area for a village is about 5 square miles.

The following is the summary of the statement issued about the population census of 1950 :—

The census covered a total area of 1,138,814 square miles, including all Part A, B and C States and Part D territories of India, according to the Constitution. But excluding the Part B State of Jammu and Kashmir and Part B tribal areas of Assam, which had not been included in any former census.

The population of Jammu and Kashmir, however, which was estimated to be 437 millions on 1-3-50 under the Constitution (Determination of Population) Order 1950 has been included in the provisional figure of 361,82 millions for the whole of India. Sikkim, which was always included in former census, has also been included in the present census.

Of this total population, the displaced persons totalled 7,479,278 spread over different States in India.

The total figures for males and females in India, excluding Jammu and Kashmir are given as 193,384,807 males and 173,506,817 females.

The statement records that during the twenty years (1931-51) the number added to the population was three times as many as during the ten years (1921-31) and twice as many as during the thirty year (1901-31).

The census covered all persons who were present in India on the 1st March, 1951 excepting non-Indian nationals who are members of the staff of diplomatic and of consular missions in India and their families.

The following table gives the total population and the totals of different sexes for different parts of India in 1950:—

State	Total Population	Males	Females	% Increase
Part A States—				
1. Assam	9,129,442	48,69,878	4.259,564	20.2
2. Bihar	40,218,916	20,172,567	20,046,349	10.1
3. Bombay	35,943,359	18,631,883	17,311,476	21.8
4. M. P.	21,327.898	10,688,811	10,639,807	8.6
5. Madras	56,652,332	28,413,661	28,538,671	14.3
6. Orissa	14,644,293	7,240,008	7,404,285	6.4
7. Punjab	12,638,611	6,780,770	5,857,841	0.4
8. U. P.	63,254,118	33,142,457	30,111,661	11.9
9. W. Bengal	24,786,683	13.319,941	11,466,742	13,5
art B States—				
1. Hyderabad	18,652,964	9,464,495	9,188,469	14.2
2. M. Bharat	7,941,642	4,128,308	3,813,334	11.1
3. Mysore	9,071,678	4,663,858	4,407,820	23.8
4. P.E.P.S.U.	3,468,631	1,873,205	1,595,426	1.3
5. Rajasthan	15,297,979	7,966,208	7,331,771	15.2
6. Saurashtra	4,136,005	2,094,968	2,041,037	0.5
7. Travancore	9,265,157	4,615,335	4,649,822	23.6
Part C States—				
1. Ajmer	692,506	359,572	332,934	17.5
2. Bhopal	838,107	438,778	399,329	6.8
3. Bilaspur	127,566	65,332	62,234	16.4
4. Coorg	229,255	125,333	103,922	35.5
5. Delhi	1,743,992	990,443	753,549	90.0
6. H. Pradesh	989,437	516,317	473,120	5.8
7. Kutch	567,825	273,363	294,462	13.4
8. Manipur	579,058	284,747	294,311	13.1
9. Tripura	649,930	339,962	309,968	26.7
10. V. Pradesh	3,577,431	1,834,610	1,742,821	6.7

In density India has a population of 96 persons per square mile. After taking into account the estimated population in Jammu and Kashmir State and also the tribal areas of Assam which were not enumerated, the population of India for an area of 1,221,000 square miles works out to 361,26 millions.

Comparative figures of density of population per square mile available in respect of some other countries, are given below :—

Japan	579
Germany	565
U. K.	536
Italy	307
Pakistan	210
France	193
China	123
Indonesia	108
U. S. A.	50
Russia	23
Brazil	15

A characteristic feature of India's population is its large increase. It is estimated that 19 children are being born every minute and every day adds to the population the equivalent of a town of 26,941 inhabitants. But this high birth-rate is counteracted by a very high death-rate. Every minute sees the death of 13 persons, which is equivalent to destroying per day a town with a population of 18,274. This high death-rate is a clear evidence of the large amount of disease and waste of life. The average duration of human life is, therefore, very short in India. The average duration of life of a male in India is 26 years 9 months as compared with 58 years 7 months in Great Britain, and 42 years 5 months in Japan.

The hot and moist climate during the long summer months of India breeds numerous parasites which prey upon the health of man. Malaria and other types of fevers prevalent in India are the cause of a great wastage of life in this country. The low standard of living to which the vast majority of the people of India are accustomed causes a low physical development which easily succumbs to the attacks of disease. It was to be expected, therefore, that with improved sanitary conditions and a rising standard of living the death-rate should fall. This has resulted in a considerable increase in the total population of the country.

Basing his conclusions on AIN-I-AKBARI, Mr. Shirras has estimated the population of India to have been 100 millions in 1590. The total population of India at the census of 1941 was 388 millions. From 1872, the year of the first regular census in India, to 1931 the total population of India increased by about 39 per cent.

The increase in population has, however, been accompanied during recent years by a more marked increase in production. Mr. Shirras supports this conclusion by the following table :—

GROWTH OF POPULATION AND PRODUCTION IN INDIA*
(INDEX NO.)

Period	Population	Production	
		Area under crops	Crop produce
1900-01 to 1904-05	100	100	100
1910-11 to 1914-15	107	110	129
1920-21 to 1924-25	108	115	133
1930-31 to 1934-35	120	118	141
1936-37	126	116	156

*The Times of India, November 10, 1938.

In order to increase the National Income in India it is necessary to reorganise our agriculture on a better plan, so that more land should be available for commercial crops. This reorganisation should enable us to grow more food on limited areas by improved agricultural methods. It should also free a large number of people from agriculture to take up work in industries and commerce and thereby reduce pressure of population on land. To absorb the growing numbers a policy of systematic industrialisation should be followed by the country. India is a country of great industrial potentialities, and, given the necessary encouragement it should not be difficult for her to hold her own in the industrial world of tomorrow. A balanced economy between agriculture and industry can thus result, enabling India to feed and clothe her millions decently.

QUESTIONS

1. Discuss the influence of geographical factors on the distribution of population in India.

2. What are the important characteristics of population distribution in :—

   (*a*) the Ganga Valley,

   (*b*) the Peninsular India ?

3. Why does most of the population of India live in villages and not in towns ?

4. What are the main features of the village in different parts of India from the point of view of population ?

5. Why is the death-rate so high in India ?

6. What steps will you suggest for raising the National Income in India ?

7. Analyse the factors which determine the irregular distribution of population in India.

8. Show how far rainfall controls density of population in India.

APPENDIX FOR PAGE 126

Cotton, 1950-51

	Lakh acres	Lakh bales
Bombay	30	6½
M. P.	27	5
Hyderabad	23	3
Madras	16	3
Madhya Bharat	15	2
Saurashtra	10	2
Punjab & Pepsu	6	3½
U. P.	1	½
Total Republic	138	29

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